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Economic Geography of India

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PREFACE TO THE TENTH EDITION

The fact that the book is passing through its tenth edition testifies to its popularity and widest recognition It has now been thoroughly revised and enlarged with new maps in keeping with the present boundaries and other economic factors

—**The Publishers**

PREFACE TO THE FIRST EDITION

This is a modest attempt to write the Economic Geography of such a vast country with such varied resources. During his fourteen years' lecturing on Economic Geography at the University, the author has felt the necessity of a small book which will give the future citizens of India a bird's-eye-view of the geographical environment in which they have been born and the economic resources that are theirs to develop. In these days when battles are fought not for principles but for 'living space', every Indian must know the possibilities of his own 'living space'. There are a number of books on the subject written either from the point of view of the foreigner whose interest is in 'exploitation', or by people who confuse Economics with Economic Geography The present book tries to deal with the development of India's resources as based on geographical factors. A full discussion, therefore, of climate, physical features, vegetation, and soil has preceded the survey of economic resources. In order to help the students in their preparation for examination, questions have been added at the end of every chapter A large number of sketch maps and diagrams have been given to facilitate the study of the subject.

University of Allahabad **R. Dubey**

CONTENTS

Introduction

India was described as 'a jewel in the British Crown.' But when we look at the squalor and poverty of the people of India, considering the vast resources of the country, we cannot fail to remark that the custodians of the 'Crown Jewels' failed miserably to discharge their duty They did not try to keep this 'jewel' bright The fact that a country so rich in economic resources as India, should be so poor, does not redound to the credit of the rulers

The poverty of the people of India is, because the resources of the country have not been fully developed They have not been even properly surveyed. It was only very recently that the Government's interest in the successful prosecution of the two World Wars led to this survey and development to a small extent But, considering the rapid progress made by such small countries as Japan and Germany before these wars, the efforts in India seemed half-hearted

The vast though undeveloped, resources of India naturally make it A Land of the Future, which will acquire its rightful place in the world when these resources are developed To help India to attain to her greatness in future, Indians' first interest in India should be to have a full knowledge of her resources We should know the extent and the geographical distribution of the present, as well as the potential resources of our country. This can be done only through the study of Economic Geography of the country

But the world outside has also got an abiding interest in India The population map of the world shows certain areas of denser population Two of these areas occur in Asia, one in India and the other, China. Of these two, India gives shelter to more than one-fifth of the total population of the world World's interest, therefore, centres on India as a country where such a large proportion of its population has found shelter

India gave shelter to the Aryan civilization which took root in its soil and spread far and wide from here subordinating for a time other civilizations of the day The world's interest, therefore, centres on India also as a home of the Aryan culture.

India's northern boundary is formed by the highest mountain of the world whose highest peak, the Everest, defied Man up to 1953 The world's interest centres on India, therefore, also as a land of adventure where Man is attracted by the beauty of the land.

Our interest, as students of Economic Geography, however, centres on India as a land of vast economic resources which have not yet been fully developed.

The idea of developing economic resources is new in India and arose only out of contact with the Western peoples For it must be admitted that 'material culture' was never a strong point in the spiritually-minded India of the past. No doubt, there are evidences to show that the Indians practised in the past highly developed arts. These arts must have been practised, however, 'for the sake of art' rather than for any considerable monetary gain These arts could not have been, therefore, widely spread in the country. The two most important elements of material culture, as used in the modern sense, capital and the market, must have been lacking then. A spiritual culture has obviously no interest in 'capital' and 'market'. These are out of the question in a society which does not possess the most efficient means of communication. The merchant who comes into frequent contact with people and studies their material wants is the person most interested in 'economic resources,' and not the ascetic who runs away from the world.

The first effective contacts of India with a merchant of this sort originated through the British, only a few hundred years ago Our economic resources have not yet, therefore, received full attention It is only within the last few years, when the Indians began to visit Europe, or America and other developed countries in increasing numbers to see for themselves the economic or material progress achieved there, that attention has been paid to the survey and development of our economic resources.

The survey is still incomplete and the problem of development still baffles solution.

India's neighbours on its land frontiers, excepting now Pakistan, are countries that are hilly and semi-arid They are not rich in natural resources Their dry climate is, however, healthy and breeds sturdy warriors. India's rich plains have always been an attraction for these poor but strong neighbours. From time to time, therefore, invasions have been made in India In the past they came from the North-west through easy passes like the Khyber, which in peace times enables India to maintain commercial ties with far-off countries. But recently the whole of northern mountain border of India has assumed special significance on account of advances in mountain warfare which have enabled China to attack India from that side, a side which was supposed to be strategically safe on account of rough terrain The study of the Economic Geography of our country o be oriented in the light of these recent developments.

India stands at the head of the Indian Ocean at the very centre of the Eastern Hemisphere commanding trade routes running in all directions and connecting India with countries lying in east, west, south-east and south-west such as China, Japan, U S A , Great Britain, West European countries, Indonesia, Australia and S. Africa, etc There is no other ocean in the world which is named after a country The Indian Ocean is the only ocean that is named after a country Two other points are of significance in this situation India is situated at the southern margin of the big land mass of Eurasia This, naturally, links it with the Air Pressure Systems of Asia

In the modern world, the opening of the Suez Canal has enhanced the importance of India's position For the routes emanating from this canal and the Strait of Malacca are forced to pass near India The Indian Ocean has very few islands to serve as supply bases for the ships The ships plying to Australia, therefore, have to visit some port in India or in Ceylon. But her coastline being regular, very little use has been made by Indians of their situation at the shores of this big ocean It is true that in the past coastal boats kept certain parts of India in touch with Arabia on the West and South-eastern Asia on the East But such a contact was necessarily limited. For it must be remembered that the most important centres of activity in India lay in the interior in the Indo-Gangetic Basin, far from the coast With the advent of the British everything changed The British being a maritime nation India now developed an ocean contact with the outside world Her land contacts now declined The most important centres of activity now shifted to the coasts where the British ships contacted us The most favourable ports on the Indian coast gradually developed into good seaports Calcutta, Bombay, Okha, Kandla, Vishakhapatnam and Madras became the leading ports as well as the centres of European civilisation in India. The forces of modernisation gradually spread from the port towns into the interior chiefly through English education and the railways which were built to connect the port towns with the interior.

The surface area of India is 3305384 sq. kms This area places India as the seventh largest country in the world The following table compares the areas of some of the biggest countries of the world.

IN ASIA

Siberia	4192000	Sq Kilometres
China (Proper)	3930000	,, ,,
Mongolia	4585000	,, ,,
India	3275000	,, ,,

OTHERS

U S. S R. Russia (in Europe)	 20619400	Sq Kilometres
Canada	 10060800	„ „
Brazil	.. 8593600	„ „
U. S A.	. . 7912400	„ „
Australia	 7860000	„ „

An important feature of the Indian area is that most of it is in the service of Man In Russia and Canada, on the other hand, vast areas remain buried under perpetual snow In Australia, there are large areas of desert, useless to Man In Brazil, there are vast areas under tropical forests Even in the U.S A. more than 2882000 sq kms are included in the Western States which are mostly a desert This consideration naturally places India in the forefront among the countries of the world

In population, India occupies an important place in the world The following table gives the population in 1961 of the countries whose areas have been compared above :—

India	43,92,02,747 (1961)
China .. .	700,000,000
Soviet Union	208,826,650
Canada . ..	18,500,000
Brazil	63,101,000
U. S. A	177,726,000
Australia	10,398,170

Taking into consideration this large area and this large population, people have often styled India as a 'continent' or a 'sub-continent' These people have obviously emphasised the differences among the people that are naturally to be expected where the numbers are so large God has not made any two people alike in all details Do we then emphasise the points of differences among the members of the same family or the points of unity ? By laying emphasis on these differences, we destroy the family Similarly, we can also destroy the community and the country Once we destroy this unity, the systematic development of economic resources becomes well-nigh impossible.

What country is there in the world where differences do not exist ? Even in a small country like Great Britain which

has hardly one-eighth of the population found in India, there are differences among people. The Welsh, the Scotch and the English do not see eye to eye in all matters They have differences in their physical features Just consider the different races that went to England to make the present English nation! The Scandinavians, the Germans, and the French, all went there. To which blood does the present Englishman belong? There are local differences of relief and climate from one part to the other, The Welsh, the Scotch and the Irish have their own language which is distinct from English But we do not call Great Britain a 'continent' We do not call Russia, which has Muslims, Christians, Jews and others living side by side, a continent Why should India then be singled out for this? It cannot be said that it is to emphasise the size of India for in that case, there are bigger countries.

Common outlook in essentials of life should be the main test to decide whether India is a country or a continent. The boundaries of India are so well defined that they leave no doubt in our minds that India is a country, a separate whole The mountain boundaries towards the land frontiers and the sea on the other separate India almost completely from Asia[1]

The geographical considerations make agriculture the dominant occupation of all people in India, Muslims and Hindus alike The crops sown by them are alike, the methods of cultivation followed by them are alike When the monsoon rains fail, they fail alike for the Hindu and the Muslim, or the Sikh The common interest of the people lies, therefore, in safeguarding India's agriculture.

There are, of course, differences in culture and language from one community to the other, from one state to the other. But these differences have always been subdued by the peculiar geographical characteristics of India The language of the ruler has always dominated the local languages, and the people of no two states of India have ever found it difficult to be understood by each other because the local languages of the provinces differ It was partly to establish unity in the country that the Hindu religion built shrines in the different parts of the country visiting of which was a religious duty for the Hindus

India is, therefore, as much a country as any other in the world

1 So says Prof Chisholm, "There is no part of the world better marked off by Nature as a region by itself than the Indian subcontinent." —L D Stamp and S C Glimour Chisholm's *Handbook of Commercial Geog.* 1954, p 554.

In spite of the present backward economic development, India has an economic importance of her own. Her teeming millions are looked upon by the world as potential buyers. The importance of the Indian market for the European manufacturer has been emphasised in this book elsewhere India is more or less a monopoly producer of certain commodities in the world like mica, shellac, etc Her cotton, iron, manganese, tea, oilseeds and some other commodities are in demand over large parts of the world. Her developing industries require machinery and skilled labourers What country is there in the world, with machinery and skill to spare, which is not anxious, therefore, to be invited to take a hand in this development ?

The following pages attempt to give the basis of India's economic importance. This economic importance has been greatly affected by the creation of Pakistan. The partition has taken away from India some of the most fertile and developed agricultural areas. This is shown by the following table showing the highest yield per acre in Pakistan and the loss India suffered due to partition.—

Yields per acre in lbs. and average for 1949-51

	1945-46		1949-51	
	India	Pakistan	India	Pakistan
Rice	703	837	961	1,216
Wheat . .	541	668	586	833
Maize ..		..	536	916
Cotton .	75	170	80	184
Jute ..	1029	1365	1048	1,400
Tobacco	725	1047	839	.

The loss in industrial raw materials is not confined to raw cotton and raw jute, the supplies of raw skins, salt, and raw materials for paper industry have also been considerably affected In respect of the manufacturing capacity, minerals (other than salt) and seaports India's loss has been negligible.

One fact, however, stands out prominently from the above discussion. India and Pakistan cannot make progress without each other's help. If India needs Pakistan's raw jute, Pakistan needs India's coal, cotton cloth and other manufactured articles,

Chapter I

The Land

India (also called as Bharat) is distinctively aloof from the main continent of Asia because of the Himalayan ranges in the north and sweeping seas on its remaining 3 sides This aloofness gives India an entity of its own, remarkable in geographical factors and environs. Crowned by the Himalayas on the north the country stretching to the south, taper off and meets at a point known as Kanyakumari or the Cape Comorin India lies wholly in the Northern Hemisphere extending from Latitudes 8°4′ 28″ and 37°17′ 53″ north and longitudes 68°7′ 3″ and 97°24′ 47″ east, dimensions being nearly 2,000 miles from North to South and about 1850 miles from east to west covering an area of 12,61,597 sq. miles approximately, it ranks 7th largest country in the world, Its coastline stretches for 3535 miles while the land frontiers constitute a total of 9425 miles.

PHYSICAL FEATURES

The core of the physical structure of India is the Peninsular India. The Peninsular part is the oldest, while all other parts were formed around it at a later period It is of interest to note that Peninsular India has mostly remained a land area, never having been submerged completely beneath the sea except locally and, that too, temporarily The only structural changes that have taken place here, therefore, have been of the nature of faults or fractures in the crust due to tension The mountains found in the Peninsula are, therefore, mostly, of the "relict" type They are not true mountains of upheaval, but are mere outstanding portions of the surface that have escaped the weathering of ages that has removed the surrounding parts of the land Due to its old age one encounters, not the 'youthful', as is characteristic of other regions of India, but 'mature' relief in the Peninsula. Its rivers have flat shallow valleys, with low gradients, because their channels have approached the 'grade or the base-level of erosion'

GEOLOGICAL HISTORY

There are two periods in the geological history of India which are landmarks in the physical features of the Peninsular India The first period is that when, owing to earth movements,

numerous cracks and fissures were made in the surface and large linear tracts subsided. This gave rise to basin-shaped depressions usually known as the 'Geosyncline' The drainage of the land discharging its sediments into these depressions ultimately filled them up These sediments later hardened into rocks known in Geology as the 'Gondwana' rocks, from the typical deposits of these rocks occurring in the Gond country to the south of the Narbada Beneath this debris was buried the luxuriant vegetation which was later converted into thick seams of coal, in some parts 20 to 80 ft. (6 1 metres to 24 4 metres) thick There is evidence enough to support the geologists in their conclusion that at this period of the geological history of India the Peninsular India was connected with such far-off countries as Australia and Tasmania, South Africa and Madagascar and Patagonia and Falkland Islands[1] It was during this period that large deposits of sandstone found in the Mahadeo and other hills of the Satpura range were made.

The second outstanding period is that when the Deccan experienced intense volcanic activity A large area of the Peninsula was flooded by quiet outpourings of lava from fissures in the earth's surface. The lava eventually raised the greater part of the Peninsular India into a plateau Denudation has now cut this plateau into numerous isolated, flat-topped and square-sided hill masses, so characteristic of the Western Ghats.

The parts north and east of the Peninsula have had a chequered history. They have been buried under the sea several times. This sea was an extension of Mediterranean Sea and extended at one time up to the south-west corner of China The geologists call it the Tethys The mighty Himalayas have been formed from marine deposits in that sea. After the Deccan had been covered with large deposits of lava, it appears that considerable earth forces were released which gradually crumpled and folded the marine deposits of the Tethys into the loftiest mountain of the world, the Himalayas. The sea receded to the west, giving place to an estuary of the combined Indus-Ganga-Brahmaputra river system. The drainage from the newly created Himalayas carried with it immense quantities of debris which quickly filled up this estuary The forces of upheaval continued and this deposit of the rivers was folded into the Siwaliks near the foot of the Himalayas.

The earth forces involved in the upheaval of the Himalayas produced a depression to the north of the Peninsula. This wide trough between the Peninsula and Himalayas was occupied for some time by an arm of the sea. It was in this trough therefore,

1. This whole southern continent was known as the 'Gondwana-land'.

that the drainage from these two areas emptied itself. This drainage was disturbed in later times by unequal earth forces which dismembered the old river system into the three separate river systems of the Indus, the Ganga and the Brahmaputra. The depression which was still left, began to be filled up by the silt brought down from the high ground by the numerous tributaries of the Indus and the Ganga Each fresh uplift of the mountains must have rejuvenated these streams This must have multiplied their cutting and carrying capacity, and so quickly filled up the Indo-Gangetic depression The depth of the alluvium in the Indo-Gangetic depression is tremendous It is estimated from 6,500 feet to 15,000 feet (1982.5 metres to 4575 metres). The trough is not of uniform depth along its whole length; it is probably at its maximum between Delhi and the Rajmahal hills, and shallowest in Rajmahal and Assam.

Some geologists, however, believe that the Indo-Gangetic Basin occupies not a trough created during the folding of the Himalayas, but a fault valley of the type of the present Narbada valley, which must have been filled up completely by the tremendous amount of silt brought down from the Himalayas The great depth of the silt deposits must be hiding the steep sides of fault valley.

The forces of upheaval are still at work in the Himalayas. The northern-rim of the trough where it merges into the Himalayan foot-hill zone is one of considerable tectonic strain. The earthquake zone of India runs along the northern edge of this trough.

PHYSICAL DIVISIONS

Based upon this geological history, India is divided into the following four physical divisions. In these divisions, the fundamental importance of the Deccan Plateau and of the Himalayas is to be noted. It is along these regions that the plains of India, which are so important economically, have been formed. These physical divisions are :—

1 The Himalayas and the adjacent mountains which surrounds the plains in the west, north and east ;

2 The Southern Plateau, sprawling to the south of the Vindhyan mountains—a solid and stable block or of earth's surface which has been denuded into a number of mountain ranges, plateaus, valleys and plains.

3. The Sutlej-Ganga Plains, flat and fertile extending from the Punjab to Assam.

4. The Coastal Plains.

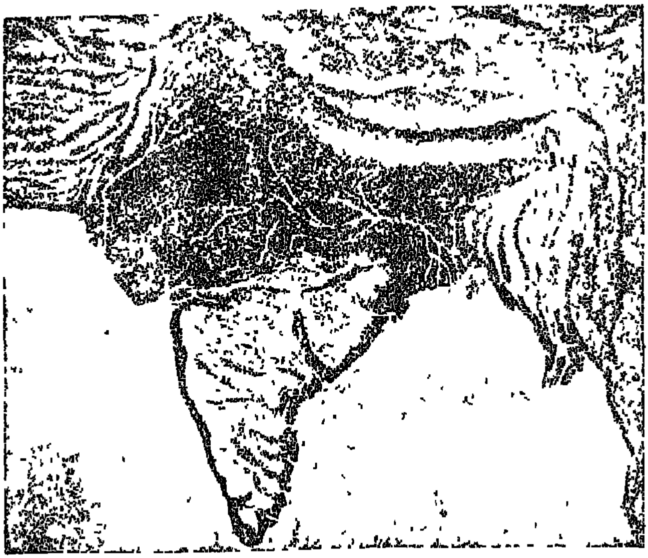

Fig 1. India and adjoining countries—Physical Features.

1. The Himalayas

The mountain mass that bounds India on the land border of Asia consists of a number of mountain ranges among which Himalayas are the most famous. The Indus and the Brahmaputra rivers divide this mountain mass into three sections (i) the Himalayas, (ii) the mountains lying to the north-west of the Himalayas, and (iii) the mountains lying to the south-east of the Himalayas. Between the Indo-Gangetic plain and the main mountain mass lie minor ranges like the Salt Range and the Siwaliks Enclosed behind these minor ranges are high plains which are known in some parts as 'Doon plains'.

The Himalayas are a range of folded mountains running from the Pamir-knot in the north-west to the border of Assam for 1,500 miles (2414 kms) which are among the youngest in the world because of their youth they have the highest Peak in the world. Mount Everest 29,028 ft (8848 metres), Kanchinjunga 28,146 ft (8580 metres), Dhavlagiri 26,826 ft (8177 7 metres), Mt Godwin Austin 28,250 ft (8611 metres), Nanda Devi 25,645 ft (7818 metres), and Gosainthan 26,305 ft (8018 metres) These may be compared with Mt McKinley 23,100 ft (7041 metres) the highest peak in the Rockies in North America Aconcagua 23,000 ft (7010.40 metres), the highest peak in the Andes in South America and Mont Blanc 15,781 ft (4810 metres), the highest peak in the Alps There are more than 140 peaks in the

Himalayas which are higher than Mont Blanc the highest peak of the Alps The Himalayas have acted as a climatic barrier by keeping the Monsoons in and shutting the cold northerly winds away from India, and as commercial and social barrier because of their very high passes[1]. The high altitudes limit travel only to a few passes, notably Jelep La and Natu La The other passes are Rohtag, Bara Lapcha and Jojila. The average height of these passes in the Himalayas is between 16,000 and 18,000 feet (4877 metres and 5486 metres) which easily exhausts both man and beast. Compare this with some of the important passes in the Alps The Brenner pass between Italy and Austria is 4,484 ft (1367 metres) The Simplon between Italy and Switzerland is 4,484 ft (2010 1 metres) high, and the Mont Cenis pass, between Italy and France is 6,850 ft. (2009 metres)

The Himalayas proper extend for about 2414 kilometres (1,500 miles) between the rivers Indus and the Brahmaputra The average breadth of the country over which they spread, is about 214 kilometres (150 miles) Over this vast extent, ridges and valleys occur in almost all directions The main folds, however, all run along the Tibetan Plateau In the north-western section, therefore, the general trend of the valleys is east-west, and in the eastern section it is north-south There is no continuous valley to separate the main range from the minor ones. Owing to their youth the Himalayan valleys are mostly V-shaped narrow gorges in which the streams are cutting backwards, so that river and valley capture is a very common feature in the Himalayas. Some U-shaped glaciated valleys also occur at great elevations where the glaciers descend from the mountains

The three ranges of Himalayas are —

(i) The Great Himalayas 2414 kilometres (1500 miles) long, average elevation 6,096 metres (20,000 ft)

(ii) The Lesser Himalayas—average elevation 4572 metres (15,000 ft)

(iii) Outer Himalayas—914 to 1219 metres (3,000 to 4,000 ft)

The Great Himalayan Range, running from the Indus to the Brahmaputra, is characterised by great elevations which remain covered under perpetual snow The highest peaks of the Himalayas occur in this range *e.g.* Nanda Devi, Mt. Everest, Dhavalagir, Kanchinjunga, Gosain Than and Nanga Parbat

1. "For ages natural barriers of high mountain walls and stormy tropical seas have largely protected India from the influence of the rest of Asia"—Clewell and Thompson, *Land and People*, Vol IV, p. 82

Both towards the Tibetan side and towards the Indo-Gangetic plain side of the Himalayan range are found ranges of lower elevations. Examples of such ranges are, on the Tibetan side, the Ladakh range and the Zaskar range, and on the plain side, the Pir Panjal range. The spurs and ridges of these, as well as the main range run in all directions and present to the eye a confusing mass of hills and valleys. Of these valleys and valley slopes those of the big rivers draining into the plains alone are important from the economic point of view. Most of these valleys, though narrow, have their sloping walls composed of limestone which usually yields a fertile soil.

Enclosed within the Great Himalayan Range and the minor southern ranges are two broad valleys which are not strictly speaking 'river valleys'. They are Kathmandu and the famous Vale of Kashmir. These are vast plains situated at about five thousand feet above sea level and enclosed by mountains on all sides. The origin of these may have been the silting up of great lakes, the evidence of which may be found, in the case of Kashmir, in the remnants, the Wular Lake and the two Dals near Srinagar.

The latest to be added to the family of the Himalayas are the Siwalik Hills which are not a continuous range like the Himalayas or the other ranges near it. They are not so high either; they are a mere two to three thousand feet as compared with the staggering heights of the Himalayas ranging in the neighbourhood of 8534 metres (28,000 ft) These hills have been made out of the debris coming from the Himalayas. The proportion of mud, therefore, predominates in these hills, which accounts for the particularly green aspect of the Siwaliks These hills are found only in middle section of the Himalayas. They are absent in its north-western and eastern sections The Siwaliks are given different names in some parts, for example, near Gorakhpur they are known as Dundwa Range and further east as Churia Range.

Between the Siwaliks and the Himalayas there are some flat valleys known in some parts as 'Doons' Hence the name Dehradun The 'Doons' are covered with deep deposits of silt and rock brought down by the swift-flowing rivers from the Himalayas These rivers, in most cases, are obstructed in their course by the Siwaliks. They, therefore, deposit a considerable part of their load in the plains lying between the foothills of the Himalayas and the Siwaliks Here and there in these 'Doons' jut out the tops of hillocks that have been buried under the silt. Usually these tops are well-wooded. In most cases rivers cross the Siwalik hills through deep gorges, but in some cases large rivers also flow out

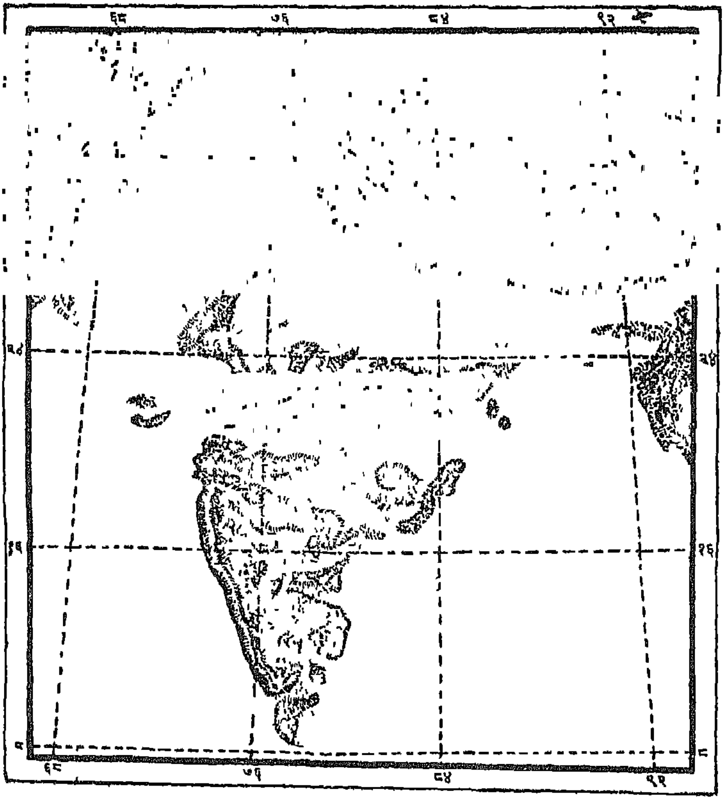

Fig 2 The Deccan or the Southern Plateau.

through the gaps naturally provided by the occurrence of these hills in sections. The gorge of the Ganga near Hardwar is noteworthy.

Western off-shoots. Towards north-west beyond Indus, Himalayas are succeeded by mountainous country of Baltistan Karakoram and the Hindukush mountains dominate this part. This mountainous country continues westward into the tribal homes of the border tribes living between Pakistan and Afghanistan. The Sulaiman and the Kirthar ranges separate this hilly country part of which lies in the North-Western Frontier Province and in Baluchistan, from the Indus Plains. Separated from the Indus plains by the Sulaiman Range are almost hill-girdled plains of Peshawar, Kohat and Bannu situated at an altitude of more than a thousand feet. These plains are similar to the

'Doon' plains found between the Siwaliks and the Himalayas in India. the place of the Siwaliks being taken by the Salt Range to the south of Peshawar plain in Pakistan.

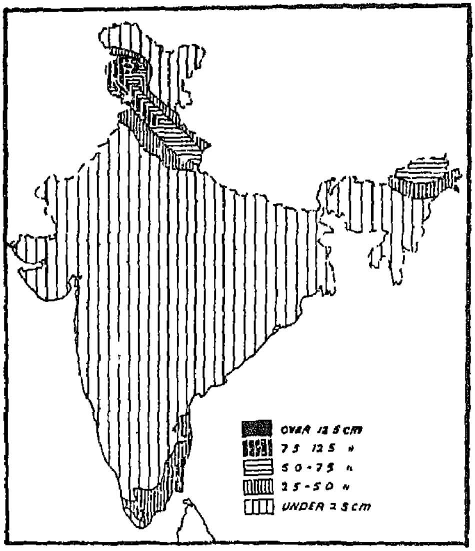

Fig 3. Distribution of Winter rainfall in India

The slope of the mountains is steep towards the Indus plains and communication is possible only through the mountain passes that follow one or the other stream crossing these mountains from Afghanistan side The most important of these passes is the Khyber pass that follows the Kabul river which is the biggest river coming from across these mountains. These passes are situated at about six thousand feet above sea-level and are not so difficult to cross as the high Himalayan passes.

The direction of valleys in this hilly region is generally from north-east to south-west, which further west in Makran becomes east-west As one proceeds away from the Himalayas in this hilly country, the climate becomes drier and drier The land forms are, therefore, more and more the result of wind erosion Alluvial deposits are less marked Stony ground predominates.

Eastern off-shoots Towards east, Brahmaputra breaks the continuity of Himalayas into the adjoining hills of Burma and Assam These hills are not so high as the Himalayas or even those on the North-Western Frontier in Pakistan. There are no broad

valleys in these hills The *Garo, Khasi, Jaintia,* and the *Naga hills* running almost east-west join the chain of the *Lushai* and the Arakan hills running north-south Towards the plains these hills generally present a steep slope Towards the interior of this hilly region the slope is gradual and there are some plateaus broken by low hills One such plateau is the *Plateau* of *Shillong.* In the south in some places the hills have receded a little giving the shape of a funnel Cherrapunji which has got the distinction of having about the largest rainfall in the world, is situated in one of these funnels. The plains in the neighbourhood of these hills are generally swampy due both to the heavy rainfall and a flat muddy surface which retards quick drainage

All along the Himalayas and other hilly regions where they join the plains, there are 'forelands' known locally as '*bhabar*' or '*ghar*' in which are deposited coarse sands and pebbles brought down from the hills by the swift-flowing mountain streams Except during the rainy season these areas are marked by dry river courses in which the water of the smaller streams sinks underground. It is only the larger rivers that flow on the surface in the *bhabar* area. These *bhabar* lands are more extensive in the western and north-western hilly region than in the east.

The water that sinks underground in the bhabar reappears on the surface where the plains begin. This water converts large areas along the water parts of the hilly regions into '*swamps*' or '*terai*' (no man's land) which is usually an ill-drained, densely forested plain The terai is more marked in the eastern regions, due to greater rainfall than in the west.

2. Southern Plateau

The Peninsular Region which is the oldest part of India, is divided into several large or small plateaus, about 610 metres (2,000 ft) above sea level. The dividing line is formed by low hills, which are either the remnants of old mountain systems, as in the case of the Aravalli Hills, or the harder parts of the plateau itself which have withstood erosion, as in the case of the Western Ghats The interiors of the plateaus are marked by a number of rivers which flow in broad, flat valleys. The fringes are considerably broken On the top, the surface of the plateau is hammocky or undulating A number of isolated hillocks are also found in the interiors, but they are more numerous near the hills bounding the plateaus

The fault or the rift, in which the Narbada river flows, divides the Plateau Region into two almost triangular portions The northern portion is known as the *Malwa Plateau* and the southern the *Deccan Plateau* To the west and north-west of the

Malwa Plateau are the Aravalli Hills which occupy a considerable east-west expanse. They narrow down considerably towards the north-east where they degenerate into low hillocks which finally end near Delhi. The *Aravallis* are crossed by a number of rivers which are dry except during the rainy season. Important among them are the Mahe, and the *Luni* flowing into Arabian Sea, and the *Chambal* with the *Banas*, flowing into the *Jamuna*. The highest elevations of the Aravallis occur in the north-eastern section in the isolated blocks, where Mount Abu is the highest point, 1714 metres (5,653 feet) above sea level

In Rajasthan the vicinity of the Aravallis is marked by patches of stony ground which are evidence of the long time during which erosion has been going on in the Aravalli area. It has already been noted that the Aravallis are the remnants of the oldest mountain system of India.

Towards the south, the Malwa plateau is bounded by the Vindhyas which are given the high-sounding name of 'Mountains', though in reality they are nothing more than the escarpment of a rift valley Running east-west along the Narbada valley, the Vindhyas join the Kaimur Range which is a similar escarpment along the Son valley Towards the north-eastern corner of the Malwa Plateau are the *Bundi hills*. The Malwa plateau, like the other plateaus in the south, is largely broken in the neighbourhood of rivers or where it approaches the Ganga Valley. These broken areas are called 'ravine land'. Examples of these ravine lands are found in the highly broken country of Budelkhand and in the valleys of the Chambal and the Banas In the interior the surface is flat, except where isolated low hillocks occur The slope of the greater part of the Malwa plateau is towards the Gangetic valley

The country south of the Narbada is called 'the Deccan' tableland It is also triangular in shape and bounded by low hills on all sides Towards the north are the Satpura hills whose highest point is in the Mahadeo Hills, on which is situated Pachmarhi, the summer seat of the M P. Government These hills continue towards the east where they meet in the Amarkantak, the hills of the Chhota Nagpur plateau. There are various local names given to the hills One distinct feature of the Satpuras and other hills of the Deccan tableland is that unlike the Himalayas, they have no conical 'peaks', they have 'flat tops' or small tablelands as their highest point The *Satpuras* have experienced in the past much faulting, as a result of which practically all the rivers in it flow in deep gorges The gorges are big or small according to the size of the rivers which have considerably modified these gorges The descent of these rivers from { higher plateau is by means of falls, as in the case of the Narba

near Jabalpur. Towards the north of the Satpura lies the fault valley of the Narbada and towards the south that of the Tapti. The flat plains of the Narbada and the Tapti lie in the region of the 'regur' or the 'lava soil' in which the rounded tops of a few hillocks buried under the deep lava deposits protrude here and there The rivers Narbada and Tapti flow against the general slope of the tableland due to their situation in deep rift valleys running east to west.

The western flank of the Deccan tableland is guarded by the Western Ghats, a portion of them is also called the Sahyadari hills They are 914 metres or (3,000 ft) high Their steep slope is towards the sea The wall-like slope of the Western Ghats towards the Arabian Sea is a clear indication of faulting which seems to have separated the Peninsula of India from the land that now lies buried under the Arabian Sea The Western Ghats are a continuous mass running north-south, across which access is possible only through a few gaps or low passes In two of the passes, the *Bhor Ghat*, and the *Thal Ghat*, access is through tunnels Except near their northern and the southern extremities, the Western Ghats run close to the sea leaving only a very narrow coastal strip Where they are very close to the sea, rocks jut out into the sea making navigation risky Only a few rivers have been able to cut their course across these hills : they all flow through very deep gorges along which communication is impossible. There are many rivers that take their rise on the western slope and many others on the eastern slope Those on the west have a shorter distance to the sea and are, therefore, swift-flowing, with small alluvial fans near their mouth and waterfalls in their lower courses Those on the east have longer and, in their lower courses, wider valleys with big deltas near their mouth Usually there are big falls where these rivers descend from the Ghats to the plateau to the east or the coastal plain to the west

Towards the east of the tableland are the Eastern *Ghats* which are in contrast to the Western Ghats just described. The Eastern Ghats are a series of low hillocks about 456 metres (1500 ft.) high separated from one another by wide gaps usually occupied by rivers coming from the Western Ghats or the Satpuras It is only in the extreme south where they join the *Nilgiri hills* that they are continuous for some distance The Eastern Ghats are the remnants of very old fold mountains like the Aravallis They are unlike the Western Ghats which are an escarpment of the Plateau They do not rank with the Western Ghats in height or steepness of slope Towards the north-east, the Eastern Ghats join the hills of the Chhota Nagpur plateau. Throughout their extent the Eastern Ghats keep away from the

sea, thus leaving a broad coastal strip. It is only near the Chilka Lake that they approach closest to the sea. The Eastern Ghats are joined to the Western Ghats through the Nilgiris, and to the Satpuras through the Chhota Nagpur hills, thus completing the triangular boundary of the tableland

South of the Nilgiris lie the *Annamalai Hills* which are separated from the former by the *Palghat Gap* This gap is about 32 Kms. or (20 miles) broad and provides easy access between the west and the east coast of India A branch of the Annamalai runs to the north-east under the name of *Palni Hills* Another branch runs to the south as the Cardammom Hills The latter continue right up to the southern extremity of the country.

Thus, the physical features of the Peninsular India have resulted partly from the very old mountain systems that remain exposed above the vast lava deposits, and partly from the lava deposits themselves that buried the old rocks to a great thickness converting the major part of the peninsula into a big tableland or plateau

The remnants of the old mountain systems in the Peninsula are the *Aravalli*, the Satpura and the Eastern Ghats These are mostly disconnected hills with rounded or flat peaks. Their elevation is generally low. They are formed largely of old sandstone, though limestone and shales are also of common occurrence in them The Peninsular region of India has experienced a good deal of 'faulting' in the past Owing to this faulting several large 'rift valleys' have been formed Some of these rift valleys are now occupied by rivers, *e.g.* the Narbada and the Tapti rivers The result of this faulting has been that the big plateu of the peninsula has been divided into a number of small plateaus; like the Malwa plateau, the Deccan tableland, the Chhota Nagpur plateau, and the Mysore plateau, etc. The escarpments facing the valleys that separate these smaller plateaus are considerably broken up into ravines, due to the erosive action of running water They, therefore, look like hills when seen from the valley itself. The Vindhyas, the Kaimurs and the Bundi Hills are examples of such dissected escarpments

The highest peak of the *Nilgiris, Dodabetta*, is over 2623 metres or (8,640 ft) of the Annamalai the highest peak is *Anaimudi*, over 2682 metres (8,800 ft) These mountains are the continuation of the Eastern Ghat mountains

The tops of the plateaus are seldom flat. They are generally hammocky or undulating. Here and there, stand a few hillocks which are the evidence of the harder parts of the plateau, resisting erosion for long Some of these hillocks, like the Fort rock of Gwalior, are the examples of 'circum-erosional mountains'

which stand out above the surrounding country, because the softer rocks around them have been washed away. The rivers that flow in these plateaus have cut for themselves deep and broad valleys, with almost flat bottoms Where these rivers leave the plateau, there are generally waterfalls or rapids

The most conspicuous feature of the Peninsula is, however, provided by the Western Ghats They are a considerably eroded escarpment of the lava plateau facing the Arabian Sea.

The Peninsular India is marked by old and hard rocks which are mainly metamorphosed rocks like the Dharwar rocks; igneous rocks like the granites and basalts that usually occur as loose isolated blocks; and old sedimentary rocks like the sandstones and limestones The basalt rock also occurs as a black thin layer on the tops of hills

The rocks of the Peninsula have suffered long denudation. This part of India, therefore, tends to be a plateau, as the elevations have been worn down The lava deposit over a large section to a great depth also made it a plateau

The peninsular region was also subjected to a considerable amount of faulting These faults occur in various parts of the region The fault of the Narbada and the Great Boundary Fault of the south are examples.

In conclusion it may be said that there is a great variety of physical features in Peninsular India Though this plateau is poor in forest resources yet it is rich in minerals and is regarded as the 'store-house of minerals'

3. The Sutlej-Ganga Plains

The Sutlej-Ganga plains appear flat with a gentle slope away from the Himalayas These plains are wholly composed of sediments deposited by great rivers of northern India The great depth of the alluvium has made this plain very fertile No rock-bed is disclosed by boring done from 152 metres to 305 metres (500 to 1,000 ft) According to Oldham the maximum depth of the soil in this plain is about 4572 metres (15000 ft.) near its southern edge The deposits include a great thickness of clay, loam and silt For miles together they show no relief features On closer examination, however, they are found to be cut up into a number of lowlands and uplands formed by the numerous rivers coming from the Himalayas The older alluvium deposited by the rivers forms the uplands which are known locally as *"Bangar"*, and the newer alluvium in the riverbeds forms the lowlands or *'Khadir'*. The older and the newer alluviums are separated from each other by the high

river banks which are in some cases as high as one hundred feet from the riverbed. The uplands in the neighbourhood of rivers are broken into extensive ravine lands, extending for miles on both sides of the rivers. The ravine lands are like the 'bad lands' of North American Western plains and have suffered considerably from soil erosion due to reckless destruction of vegetation cover of the soil.

The lowlands and depressions become more prominent as one approaches the delta of the Ganga. The Ganga Delta is the largest delta in the world, having an area of about 51,306 kms (31880 sq miles) A large number of the depressions in the lower section of the Ganga plain are old river beds which have been cut off by a change in the river course. These depressions are called locally the 'bils'; while the river banks are called *Chars*. The significance of the 'Chars' is very great in the location of villages in the delta region where the depressions are entirely flooded during the rainy season

It should be noted that no part of the Indo-Gangetic plain is "peneplain".

4. Coastal Plains

The Southern Plateau is surrounded on all sides by low plains It is against the hard rocks of the plateau that the plains have been formed Towards the north is the Sutlej-Gangetic plain; towards the east the Gangetic plain and the eastern coastal plain, towards the south also the eastern coastal plain; and towards the west, the western coastal plain which joins the Thar desert plains

The eastern coastal plain, which is known as the *Payanghat*, may be considered in two sections: The lower section which consists of the deltas of the rivers; and the upper section which consists mostly of the plains lying in the upper courses of the rivers The lower section is entirely alluvial, while the upper section is partly alluvial and partly a Peneplain formed by the denudation of elevated relief This peneplain is covered in some places by thin alluvium of the river, while elsewhere old rocks still stand out prominently The lower section is fringed by a series of sand dunes in the vicinity of the sea These sand dunes have been formed by the action of waves In some parts enclosed within these sand dunes, are lagoons The lakes *Pulicat* and *Chilka* are in reality big lagoons of this type Immediately along the sea a sandy beach stretches all along the sea coast. The Payanghat extends through the Palghat gap to the western costal plain.

The western coastal plain, beginning from the Malabar coast, runs from the south to the north all along the Arabian Sea. Towards the south the plain is very narrow about 64 kms. (40 miles) except where the Western Ghats have receded. The southern section is also characterised by a number of long and narrow lagoons which are navigable for hundreds of miles. These lagoons are unlike those found on the eastern coast in this respect, because the latter are generally surf-beaten and shallow which are joined by canals, which serve as good coastal traffic by boats, rafts and canoes. The western coastal plain broadens to the north of Bombay into the alluvial plains of the Tapti and the Narbada, and further north into Gujrat. Part of the coastal plain in Gujrat and Kathiawar, as well as in Cutch, is also a *"Peneplain"* where the old rocks still appear on the surface. Gujrat and Kathiawar plains are partly covered by the regur of the Black Cotton Soil The monsoon floods being enormous silts help the growth of enormous forests and plantations.

The western coastal plains merge in the extreme north into the Thar and Rajasthan deserts. These parts are characterised by vast deposits of sand or silt, partly due to the dry old river courses and partly to the emergence of vast plains from under the sea which is receding in this part.

The Thar and Rajasthan deserts, in their western and northern sections are marked by sand dunes covering hundreds of square miles of area. These sand dunes are due generally to the blowing in of sand from the neighbouring dry plains by the prevailing winds.

QUESTIONS

1 What is the economic significance of the Himalayas?

2 How do the Siwaliks differ from the Himalayas? What is their economic significance?

3. What is a 'Doon'? What are its physical characteristics?

4. How do valleys of the Deccan tableland differ from those of the Himalayas? What is the economic significance of this difference?

5 What are the physical characteristics of the Indo-Gangetic plains?

6 What is meant by 'ravine lands'? Where do they occur most in India and why?

7. How do the Payanghat plains differ from the Indo-Gangetic plains? Does this difference in any way affect the agriculture of the two plains?

8 Describe the main features of the Eastern Ghats and write how they affect the lines of communications?

9 What are the physical characteristics of the West-Coast plains? Account for them

10 What are the characteristics of the Aravalli Hills? How do they contrast with the Vindhyas?

Chapter 2

Climate

Climate occupies the fundamental position in the study of Economic Geography On the one hand, it determines, to a large extent, the production of commodities, and on the other, it controls and creates markets for them by determining the wants of men. In no other country is the production of commodities so dependent upon climate as in India Millions of poor farmers gaze at the sky during the summer months in the hope of seeing the clouds that bring them rains which start agricultural operations of the year. Even in these days of economic progress, untold misery is the lot of the Indian farmer if, perchance, the rains fail, or some other climate phenomena destroy his crops Climate affects not only the agriculture, but all other aspects of India's life. Our clothing, our houses, our roads and railways, our food and our very health and capacity to work depend upon climate.

India's climate is governed by:—

(a) Her relation to the big land mass of Asia; and (b) her relation to the Indian Ocean. The Monsoon type of climate, under which Indian climate falls, is directly the outcome of the extraordinary pressure conditions that develop in Central Asia during the winter and summer months The word 'Monsoon', derived from the Arabic word *MAUSIM*, meaning season, implies seasonal change of prevailing winds During winter, the prevailing winds are off-shore from land, during summer, these winds become onshore from sea This change from the land winds to sea winds and *vice versa* is the cause of all the characteristics of a monsoon climate.

To understand Indian climate, therefore, it is necessary for us to study the pressure conditions of Central and South-Eastern Asia, which bring about this change of winds.

In the following map is given the distribution of air pressure for January in Asia. It will be noticed that at this time an anticyclone with high pressure covers the land mass of Asia. The centre of this anticyclone is in Siberia near lake Baikal. The average pressure for Irkutsk at this time is 770 mm. A secondary centre of this anticyclone has established itself in the Punjab: the pressure at Peshawar being 765 mm

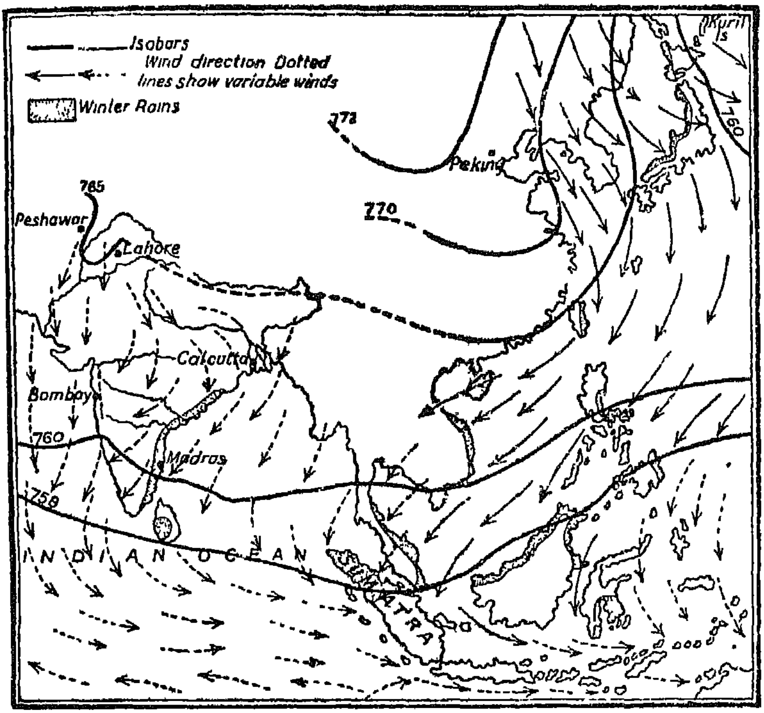

Fig. 4. Pressure and winds for January

As opposed to this, low pressure occurs in the North Pacific near the Kurile Isles and in the equatorial regions to the south. Further south in Australia also there is low pressure, as it is summer there. As the wind blows from the high pressure to the low pressure region, this pressure distribution naturally places the whole of the eastern and southern Asia under the regime of land winds which are called 'Winter Monsoon'. These are usually dry, oc-shore winds which merge, over part of the area, with the N E Trade Winds The Winter Monsoon may also be called the Dry Monsoon As appears on the map these winds blow more steadily in eastern and south-eastern Asia than in the Indian region where they are weak and irregular

Now, look at the map (Fig 5) giving the pressure distribution for June. The increasing amount of heat received from the sun and the consequent heating of the big land mass of Asia has changed the entire position The high pressure area now lies on the Pacific, south of Japan. There is another high pressure area on the Indian Ocean and in Australia where it is

winter now. The continent of Asia, intensely heated, is almost entirely a low pressure area, with three centres of marked low pressure; one of which is in Pakistan near Multan where the pressure, about 747 mm is the lowest of all the three centres. The prevailing winds, therefore, become onshore, blowing from the sea to the land.

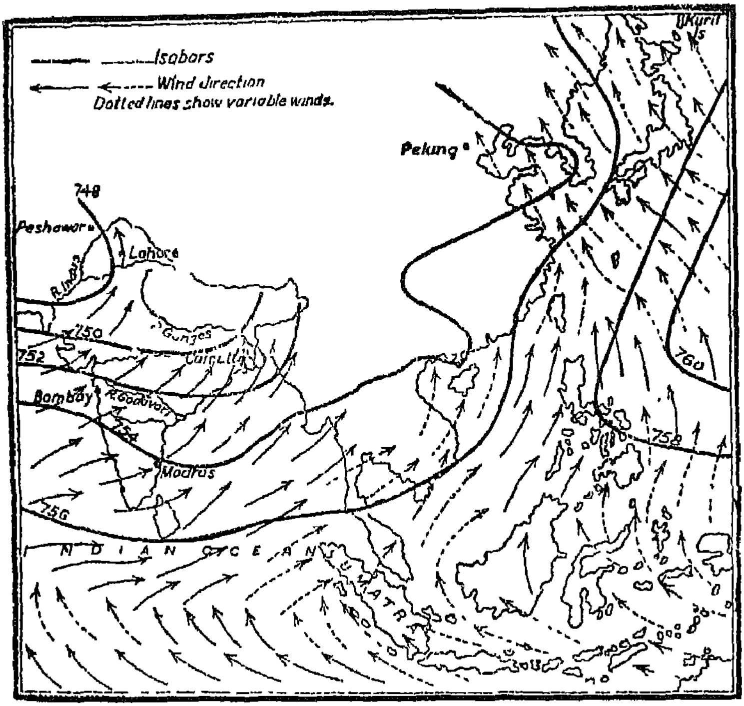

Fig. 5. Pressure and winds for June.

In the beginning, while the summer temperatures are yet rising, these sea winds are drawn only from over short distances of the sea But gradually as the low pressure area over Pakistan intensifies even the S E Trade winds blowing in the southern hemisphere join the general movement of air towards this low-pressure During May the pressure in Pakistan is about 750 mm ; during June it becomes 748 mm. but during July it becomes as low as 746 mm near Multan This causes onrush of the monsoon These winds come to us almost suddenly, as South-West or Summer Monsoons'.

Gradually as the sun starts back on its southern journey, the temperature in India becomes lower and the old pressure

conditions re-establish themselves The South-West Monsoon, therefore, weakens and we have once again the Winter or Dry Monsoons The period of transition from Summer to Winter Monsoons lasts from September to December, after which the Winter Monsoons are in full control until

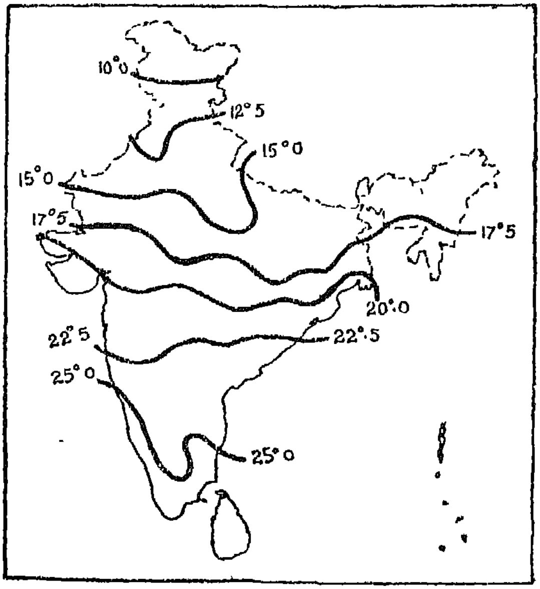

Fig 6 Mean temperature in January (in centigrade)

about May Thus from June to December, India is under the influence of the South-West Monsoons coming from thousands of kilometres of warm ocean From January to May, it is under the influence of the off-shore Dry Monsoons coming from land. The oceanic and land character respectively of these monsoons determine the salient features of Indian climate

WEATHER IN THE DRY MONSOONS

Considering generally, the weather in India during the period of Winter or Dry Monsoon is marked by "clear skies, fine weather, low humidity and temperature, light northerly winds and a large diurnal variation of temperature".[1] There is, however, a great difference between this generalised statement and the day-to-day realities The anticyclone, mentioned above covering North-West India weakens from time to time. This is characterised by the inraid of a number of cyclones

1. Normand, *The Weather of India*

which introduce an element of change in the weather condition of northern India during winter. About nine-tenths of these cyclones come here from the Mediterranean *via* Iran; while the rest are born in Central India or in the Arabian Sea Their path generally lies along the Himalayas. The country south of 21° N. is not visited by them generally. These are similar in type to the European cyclones, though not so intense. Most of these depressions give a small amount of rain to the whole of Northern India, and heavy snowfall in the higher Himalayas The passage of these cyclones is accompanied by marked changes in temperature. Their approach is marked by

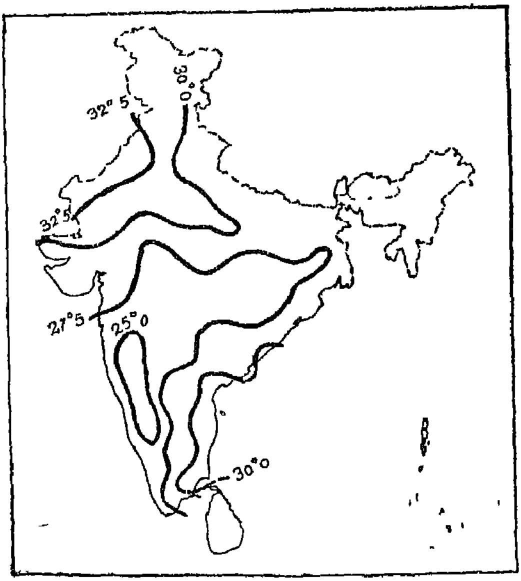

Fig. 7. Mean temperature in July (in centigrade)

a rise in temperature and their end is marked by a fall in temperature It is then that the weather becomes frosty.[1] The amount of snowfall from these cyclones in the mountains depends upon the moisture in the air drawn into them. When more of the air from the Arabian Sea is drawn into them the snowfall in the hills is considerable This is possible only when the path followed by them is more southerly The path followed by these cyclones is determined by the equatorial doldrums When the position of the doldrums is more to the north, the

1 Temperatures fall occasionally from about 8° to 11°C below normal, and several degrees of frost have occurred on rare occasions in the plains of north-west India.

path of the cyclones in India is more to the north. There is, therefore, less of the air from the Arabian Sea drawn into them. But when the position of the doldrums is more to the south, the path followed by the cyclones is more to the south This allows more moisture-bearing air to be drawn into the cyclones, and heavy snowfall in the mountains is the result.

Heavy snowfall in the hills causes a very cold weather to follow the cyclones. Owing to the circular motion of air around the low pressure in the cyclone, the cold air of the snow-covered mountains is brought to the plains of India where a cold wave results The frequency of these western depressions is on an average, 2 in November 4 to 5 per month during December to April and about 2 in May.[2]

The first period of the Dry Monsoon is characterised by low temperatures, which are lower in the north-west, where the anticyclone lies, than in the south which is nearer the equator.[3] The temperature during this period throughout the Indo-Gangetic Basin is considerably lower than in the peninsular India The following table shows this —

Winter and Summer Temperature

(In degree centigrade)

	Winter (Jan)		Summer (May or June)	
	Max.	Min.	Max.	Min.
Peshawar ..	17·2	5·0	40·5 (June)	25·0
Lahore .	20 6	4 4	41 1 (June)	26·1
Delhi	21·1	8·8	40·0	26·6
Allahabad ..	23·3	8 8	41 6	26·6
Nagpur .	28·3	12·7	37 7	27·7
Madras .	28·8	19 5	36 6	27 2
Calcutta	26 6	12·7	36 1 (April)	23 8

The second period, which may be said to begin from March is marked by an appreciable rise in temperature and decrease of barometric pressure in India due to the northward

2 M S. Randhawa, *Agriculture and Animal Husbandry in India*, p 35.

3 The mean maximum ranges from about 28 8°C in parts of the Peninsula to 18 3°C in the north-west, while the mean minimum decreases from about 23 8°C in the extreme south to below 4 4°C in the north-west.

march of the sun. Fig. 7 shows that the month of July records the highest temperatures over greater part of India. During the hot weather months—March to May—local sea winds prevail in the coastal districts and dry land winds in interior. Hence, temperature is highest in the interior and there is a large contrast of temperatures between the interior and the coastal districts With the steady northward movement of the area of greatest heat in India, the equatorial winter bulk of low pressure also moves northward. The isotherms are closed curves with a central area of highest temperature In March the highest day temperature occurs in Deccan—about 38°C In April the highest temperatures, 38°C to 43°C, occur in the tract lying from Rajasthan and the Punjab to Chhota Nagpur, Orissa and Sircars The maximum temperature in May is over 40 5°C over most of the North-West and Central India. In the north-west desert, day temperatures of 49°C or over are not infrequent The mean minimum temperature exceeds 21°C. over the whole country in May and is over 26.6°C in the eastern half of the Peninsula. These temperatures increase from the south to the north and north-west Thus, both the highest and the lowest temperatures in India, are recorded during the period of this dry, off-shore monsoon. The country cannot get the benefit of sea during the regime of this monsoon.

During this period important changes take place in the surface air movements over India The northerly winds of the winter monsoon get modified and air circulation over India and the adjacent seas becomes a local circulation characterised by increasing land and sea winds in the coastal regions. In northern India the winds are strong westerly during day and weak with variable direction during night.

Violent local storms often form in regions where deep humid winds from the sea meet the hot dry land winds These storms are often accompanied by violent winds, hail and torrential rains, and are on that account very destructive In West Bengal and Assam they are known as 'Norwesters' on account of the accompanying squall being usually from the north-west. Sometimes the showers are heavy and prolonged—this is chiefly the case in the damp regions and eastern Bengal and Assam Hail storms are comparatively more common in the Punjab, the west U P and in Assam and its neighbourhood They also occur in the central parts of the country and the ocean

About the close of the period of this dry monsoon, the days in the Upper Ganga basin are characterised by the blowing of the dry scorching westerly winds, locally known as 'Loo' These winds are drawn owing to the unusual heating of the

plains during the day They stop blowing during the night The afternoon and late evenings are sometimes marked during this period by hurricanes, which also are due to local heating Sometimes they move at terrific speed seventy or eighty miles an hour, and cause considerable damage

But while the 'loo' blows in the north, in the extreme south the proximity of the sea allows oceanic winds to penetrate to some distance into the land and give light showers, as soon as the summer temperatures have risen considerably These rains are not, however, part of the monsoon rain They are only light, as the winds drawn are only from a short distance of the sea and are not, therefore, so highly saturated as the south-west monsoon The south-west monsoon sets in only much later when the low pressure at the equator south of India has disappeared, thus allowing the South-East Trade Winds to be drawn across the equator as South-West Monsoons.

During the winter the general flow of surface air over the country is from north to south, north-westerly in the plains northerly in the central parts and north-easterly in the south of

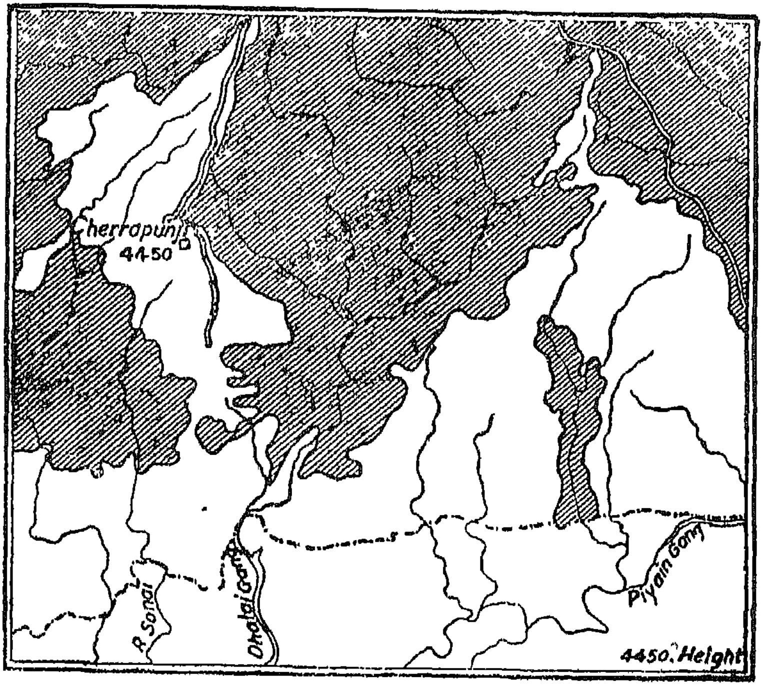

Fig 8 Position of Cherrapunji (Hills are shaded)

the peninsula and the neighbouring seas The winds blow with little speed because of the anticyclonic conditions that prevail over most of the country In this season the air is mainly of continental origin and hence of low humidity From about the middle of December. the serenity of the weather in north India is broken at intervals by a series of disturbances which travels eastwards across Persia, northern India and China. On an average four to six disturbances may be expected in each of the months of January and February. The precipitation associated with them is small in amount but very important for winter crops of north-west India

Taking the season as a whole, temperature is lower in the north-west and increases eastwards and southwards Raintall is greatest in north-west and decreases eastwards and southwards generally

WEATHER IN THE WET MONSOON

The Summer or Wet Monsoon is divided into two branches (i) the Arabian Sea branch and (ii) the Bay of Bengal branch; owing to the peculiar shape of the Indian Peninsula The Bay of Bengal branch strikes land much later, but gives rain to the greater part of the country The Arabian Sea branch, though more powerful, usually spends itself up in ascending the Western Ghats which deprive it of most of its moisture Certain currents of the Arabian Sea branch reach the interior of the Peninsula through the Narbada gap and join the Bay of Bengal current in Chhota Nagpur The Palghat gap similarly allows this monsoon to reach into the interior of the peninsula.

The Summer or West Monsoon is also called the South-West Monsoon, because it blows originally from the south-west Its direction over India is, however, modified by the general position of the low pressure area in the north-west; to which it is naturally attracted; and the direction of mountains, especially the Arakan hills and the Himalayas The result is that in U P the so-called South-West Monsoon actually comes from the East

With the advent of the South-West Monsoon there is an appreciable fall in temperature The high humidity of air, however, makes the moist heat unbearable The conditions, in fact, in every way resemble those in the equatorial regions.

The chief importance of the South-West Monsoon lies in its rainfall This Monsoon has been blowing for thousands of miles over a warm ocean capable of much evaporation It is, therefore, highly saturated when it strikes land. The Bay of Ben-

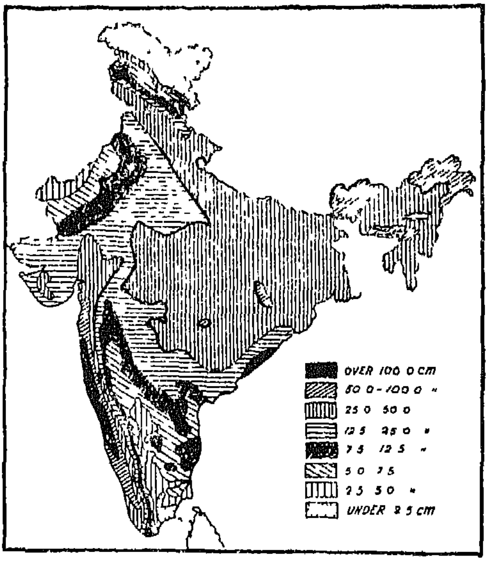

Fig 9 India—Mean Annual rainfall

gal branch strikes the Arakan Coast and thence passes on into funnel-shaped formation of the Garo and Khasi hills, shown in Fig 8 The ascent of these moisture-laden air currents in this funnel gives Cherranpunji an average annual rainfall of 1080 cms which, if allowed to collect, will submerge completely a modern four-storeyed house After emerging from this funnel, the Monsoon air loses much of its buoyancy and moisture, so that Shillong, which is only about twenty-five miles away from Cherrapunji, gets only about 215 cms of rainfall annually. The Monsoon currents now follow their path along the Himalayas giving rain until they reach the Punjab where they meet another section of the Arabian Sea Branch The rainfall decreases as these currents move into the interior, as the supply of moisture in them decreases gradually The rainfall is greater near the Himalayas, and near the coast in Bengal, than it is in the interior or away from the Himalayas[1]

1 The following figures show this tendency —

Darjeeling gets 126 4″ (321 cms) of rainfall, Shillong 84 6″ (215 cms), Simla 61 0″ (155 cms), Dehradun 85 0″ (216 cms), while coastal stations of Bombay, Madras and Calcutta get 71 2″ (181 cms), 49 9″ (127 cms), and 62 9″ (160 cms) respectively

There is a marked decrease in rainfall from east to west *i e* while Calcutta gets 62 9″ (160 cms), Patna gets only 46 6″ (118 cms), Allahabad 41 8″ (106 cms), Lucknow 40 0″ (101 cms), Kanpur 35 9″ (91 cms) and New Delhi gets 26 2″ (66 cms)

(Source *India*, 1962, pp 10-12)

Distribution of rainfall in India depends largely on its orographical features It has been remarked, if the hills and mountains of India were effaced, the country will receive much less rainfall.[2] Part of the rainfall from the Monsoon in India is *Orographical* and part *Cyclonic* or *Convectional.* All along the Himalayas and the Western Ghats the Monsoon currents try to ascend the mountain barrier which results in condensation of moisture and rainfall In this orographical or relief type of rainfall the windward slopes of mountains get more rainfall than the leeward sides, which are in the rain shadow.

The cyclonic rainfall, on the other hand, is due to the passage of a number of depressions, or cyclones, some of which are of local origin due to local heating, while others take their rise on the neighbouring sea and move landward These depressions intensify and concentrate rainfall in their vicinity The rainfall is, therefore, sometimes more and sometimes less in a particular locality in India according to the intensity of the cyclone. Consequently, the Summer Monsoon does not give continuous rain in any part of India Bursts of general rain alternate with breaks, partial or general Intensification by these depressions often lead to floods This pulsatory character of the Monsoon rainfall is one of the most important features, and is economically important for the proper growth of crops.

It is also due to these depressions that lands away from the mountains are able to get rainfall For ordinarily the Monsoon winds try to cross the Himalayas and concentrate their rainfall there only It is only through the depressions that the moisture-bearing monsoon passes over the plains and gives rain there.

Convectional rainfall also takes place sometimes due to local heating which produces cumulous clouds in the afternoons, This type of rain is strictly local and occurs mostly in autumn or spring (*i.e.* October and March) Heat produces a local convectional current in the air which rises up The moisture in that rising current is condensed at some height and clouds form These clouds on rising further begin to give rain. The convectional rains in India are generally very light, as this phenomenon occurs in India at a time when the temperatures are not ordinarily very high The local heating, therefore, cannot produce very strong convectional currents in the air which could rise very high and thus give much rain.

Usually the strength of the Monsoon currents and the accompanying rainfall increase from June to July and remain

2 Normand, *The Weather of India*.

steady till about the end of August. The currents then begin to weaken and do not reach far into the interior; that is to say, the Monsoon begins to retreat. This retreat of the Monsoon is due to the retreat of the sun towards the southern hemisphere. The retreat begins first in those parts where the advent of the Monsoon was the latest, that is to say, from places far into the interior. The following table shows the approximate dates when the S.-W. Monsoon starts and ends in certain States in India:—

Monsoon Time Table

State	Commencement	End	Duration days
Bombay	5th June	15th October	132
Bengal	15th June	15th-30th October	132-137
U P.	25th June	30th September	97
Punjab	1st July	14th-21st September	75-82

The Arabian Sea monsoon current retreats southwards from Rajasthan, Gujarat and the Deccan by a series of intermittent actions The Bay of Bengal current similarly retreats down the Ganga plain. The low pressure conditions previously prevailing in North India disappear by October, and are transferred to the Bay of Bengal by the beginning of November. This retreat of the Monsoon is followed by dry weather in Northern India and general rainfall on the coastal districts of Madras and Orissa States where October and November are often the rainiest months of the year

The retreat of the S. W. Monsoon is associated with a number of storms which affect only the coast, especially along the Bay of Bengal On an average 1 or 2 severe cyclones may be expected in the pre-monsoon period, and 2 or 3 in the post-monsoon period These storms (Tornadoes and Typhoons) cause sometimes very high tidal waves which do considerable damage in the low-lying areas near the coast The tidal wave accompanying the Bakarganj storm of 1876 was one of the most destructive on record. About one lakh people were drowned in about half an hour on the alluvial flats of the River Meghna About two decades ago a cyclone of this type passed over Bengal, details of which were given in a communique as follows:—

"A heavy cyclone from the Bay passed over several districts of Bengal on October 16, 1942 It began at about 7 or 8 o'clock in the morning on October 15 and spent itself up in the early hours of the morning

of October 17. In the afternoon of the 16th there was a high tidal bore forced up by the cyclone from the Bay which broke into the mainland and devastated a considerable area in the southern part of Midnapore and 24-Parganas The cyclone was accompanied by heavy rain At certain places it was as heavy as 12 inches in less than 24 hours All the rivers in these districts were in heavy flood, due to the tidal bore, rain and the force of the wind In the worst-affected areas, there was a heavy loss of human lives—the present estimate being not less than 10,000 persons in the Midnapore district and 1,000 persons in the 24-Parganas district The loss of cattle was even heavier, nearly 75 per cent As to houses, practically every kutcha house was severely damaged or destroyed"

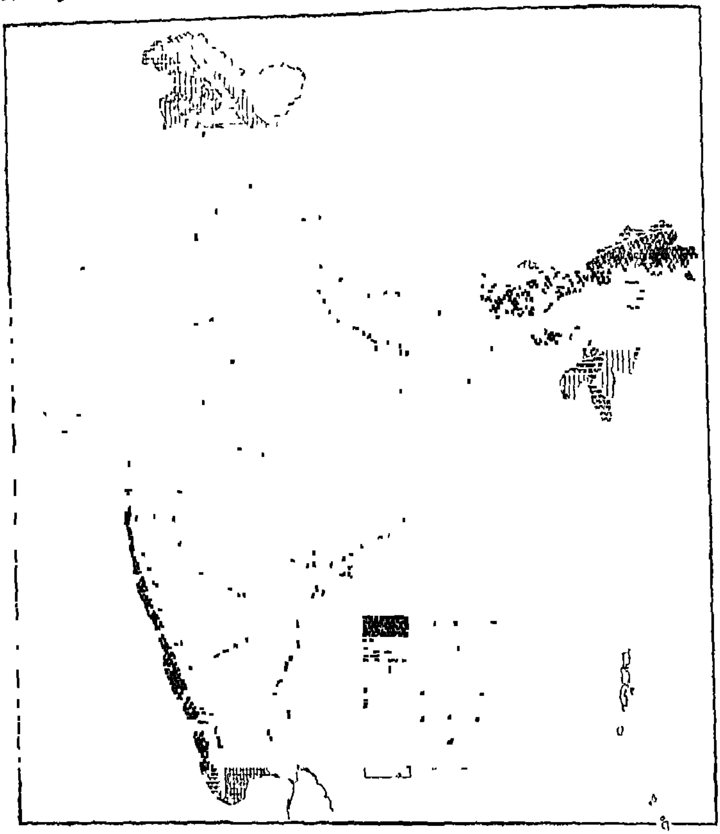

Fig 10. India—Mean Annual Rainfall (in centimeters)

DISTRIBUTION OF TEMPERATURE

The Tropic of Cancer divides India roughly into two equal parts, the Warm Temperate and Tropical But on account of the monsoon character of Indian climate, very little effect is produced by the Tropic of Cancer on the distribution of temperature in India. The extreme south is the only part of India

where latitude may be said to have a preponderating influence on temperature distribution. But there, too, the peninsular character of land lets in oceanic influences which considerably modify temperatures.

In Northern India, or the part north of the Tropic of Cancer, the temperatures during the winter months are controlled, apart from the slanting rays of the sun in winter, by the anticyclone that covers this area then. The temperatures vary between 13°C and 18°C. A slight change occurs in these temperatures whenever cyclones disturb the anticyclone For a few days, marking the approach of the cyclone, the temperatures are slightly higher. For a day or two, signifying the end of the cyclone, the temperatures are slightly lower It must, however, be remembered that it is during the closing days of the cyclone that the lowest winter temperatures are recorded locally.

In Southern India, or the part south of the Tropic of Cancer, the temperatures during the winter months are controlled by the proximity to the Equator and the oceanic influences The temperatures generally increase from about 18°C near the Tropic of Cancer to about 26 6°C at the southern extremity. There are, however, local variations, due to elevation above sea level or proximity to the sea Fig 6, giving the isotherms for January, shows (by the southerly bend of isotherms) that winter temperatures are warmer on the east coast than on the west coast This is largely due to the higher elevations on the west This effect of elevation is also brought out clearly by the isotherm of 23.8°C enclosing the plateau of Mysore

The summer temperatures in Northern India are largely the effect of.—

(i) Direct rays of the sun, owing to the sun being overhead in the northern hemisphere.

(ii) Continentality, emphasising land influences far from the sea

(ii) Anticyclone, which maintains steadily rising temperatures

(iv) Modification by the breaking of the South-West Monsoon which brings rain.

As the sun crosses the Equator for the north, temperatures in India begin to rise. But Fig. 7, giving isotherms for May, shows that there is little difference in the summer temperature

between Northern India and Southern India The isotherm of 32 2°C covers the greater part of India, more or less surrounding it. In the neighbourhood of the sea, the isotherms tend to follow the direction of the coast This is due to the penetration of the oceanic influence

During June when the sun shines overhead at the Tropic of Cancer, the highest temperatures are not found in that region The highest temperatures are found in areas that have not yet received the monsoon rains. Thus, the hottest temperatures in India during June and July are in the south-west of the Punjab, Central India and Rajasthan. In all areas where the south-west monsoon has penetrated, the temperatures have come down considerably.

The distribution of day-to-day temperatures over the different parts of India is, however, entirely different from the above generalised, seasonal distribution of temperatures The temperature may rise above 38°C. in a place in west Pakistan on day during summer, and may fall to 4.4°C or thereabouts during the night Both the highest and the lowest temperatures have been recorded in Jacobabad in Sind (Pakistan) On individual days in May maximum temperatures exceeding 48 8°C have been recorded in west Rajasthan, the highest temperature recorded being 50°C at Shri Ganganagar

There is a considerable range between winter and summer temperatures in India, except in Malabar Malabar may be considered to enjoy the Equatorial type of temperature regime, in which the difference between winter and summer temperatures is very little The range of temperature increases as one proceeds into the interior of the country from south to north While in Malabar the range between the hottest and the coldest month is about 33°C and in south-eastern Madras about 6.6°C, in south-western Punjab it is more than 22°C

The range of temperature is much greater in the interior of the country and especially in the north-west India than on the coast and in the neighbourhood of the seas, and as a general rule is greatest in the driest spring months and least in the rainy season On the mean of the year the diurnal range is 14°C to 16 5°C in the north-west India and decreases towards the east and south. The range is 8 25°C to 11°C in the north-east India and the coastal districts from Saurashtra to Lower Burma. Throughout the dry tract to the west of the Jamuna and the Aravallis, the daily range of temperature is greatest in October and November when the diurnal range is not less than 16 5°C and rises to 22°C in places In the north-west of the Peninsula and adjoining areas the greatest range of 16.5°C to 19°C occurs in February and March.

An important feature of the distribution of temperature is the sudden change from winter to summer, and summer to winter The period of spring and autumn is, therefore, limited in India. This feature is more marked in the north than in the south. The following table gives the temperatures of three different areas to illustrate the comparative steadiness of temperatures during the period of the South-West Monsoon, and the sudden rise and fall of temperature during spring and autumn respectively.

Mean Monthly Temperatures in degrees C

Areas	Jan	Feb.	Mar.	April	May	June	July	Aug	Sep	Oct.	Nov	Dec
Punjab, S -W	12 2	14·4	20·5	26·6	32·2	34 4	33 8	32·2	30·5	25·5	18·8	13 3
Bengal	18·3	20·5	23·3	28·3	28 8	28 8	28 3	28 3	28·3	26 6	22·7	18
Madras S.-E.	24·4	26 1	28·3	30 0	31·1	30 5	29 4	28·8	28 3	25·0	26·1	24.4

In the above table, in the Punjab from February to May there is a rise of 17 8° C and a similar fall from September to December. But from June to September there is a change of only 4°C In the other two cases also the same tendency is present.

This feature of temperature distribution has a great significance for crop production in India. The uniformly high temperatures during the period of the greatest rainfall are of great benefit for the quick growth and maturity of the Summer or *Kharif Crops* The low stocks of food, which the Indian peasant usually has about this period of the year, are thus quickly replenished The sudden change from summer to winter enables the cultivator to sow the Winter or *Rabi Crops* while the ground moisture received during the rainy season has not dried up, and is still available for the germination of the crops The sudden change from winter to summer, however, proves disadvantageous for the best maturity of crops.

RAINFALL DISTRIBUTION

In the following table are given the monthly rainfall figures for India. It will be clear from these data that India gets more of her rain (about 90%) from the South-West Monsoon, and secondly, that 78% of the rains are received in the months of

June, July, August and September, *i.e.* 2/3 of the year remains dry:—

Monthly Rainfall in Cms.

Month	Rainfall	Percentage	Remarks
January	3,941	1 0	
February	5,156	1 5	
March	5,820	1·8	
April	8,388	2 5	In Assam eastern Himalayas and Western Ghats.
May	19,277	5·6	
June	55,659	16 3	
July	89,130	26·2	78·7% in these four months
August	74,982	22·4	
September	47,244	13 8	
October	18,650	5 5	West Coast, Assam and Madras Coast
November	8,572	2.5	
December	3,331	0.9	

The following table gives the normal seasonal rainfall in various sub-divisions of India[1].—

Sub-Division	Full year (in cms.)
1. Assam	244·15
2. W. Bengal	187·82
3. Orissa	142·27
4 Chhota Nagpur	127·95
5 Bihar	120·52
6. East U P.	97·82
7. West U. P.	93·95
8. Punjab E. & N.	58 12
9. Punjab S. W.	23·37
10. East Rajasthan	63 00
11. West Rajasthan	32 60
12. Kashmir	103 35
13. Central India (West)	84·07
14. Central India (East)	96·45
15. Gujarat	81·72
16. Konkan	273·32

1. M. S. Randhawa's *Agriculture and Animal Husbandry in India*, 1958, p. 33.

Sub-Division	Full year (in cms.)
17. Deccan	77·17
18 M P. (West)	113·52
19. M. P. (East)	130 10
20. Malabar	259·35
21 Mysore	90 02
22. Madras (S. E)	87 75
23. Madras Deccan	61 30
24 Madras Coast (N.)	100 40

The monsoon rains in India are often marked by the following four important variations from the normal.—

1. The beginning of the rains may be delayed considerably over the whole or a part of the country

2. There may be prolonged breaks of rains lasting over the greater part of July or August when the summer crops needing plenty of moisture are just growing.

3. The rains may end considerably earlier than usual, causing damage to standing crops and making the sowing of winter crops difficult. Long breaks or an early abrupt termination of rains is disastrous to crops and produce droughts and famines.

4. The rains may persist more than usual in one part of the country and desist from another part The last one constitutes the most common abnormality.

The summer rainfall in India comes in heavy downpours leading to a considerable run-off. This results in extensive soil-leaching and soil-erosion London's 60 cm of annual rain, for example, comes in 161 days in light drizzles leading to considerable sinking of rain water, while Bombay's 177.5 cm., comes in 75 days only, causing large proportion of the rain water to run off in torrents.

It will be realised that the alternation of a wet and a dry period is the fundamental feature of Indian climate Owing to this alternation, the significance attaching to a rainfall distribution is naturally great in a hot country like India, whose life depends mostly upon agriculture The map in Fig. 9 shows that over the greater part of the country **most of the rainfall comes during the period from June to October.** The months of November and December are important for rainfall only along the eastern coast of Madras and Orissa. During January and February, however, there is a small amount of rainfall from

winter depression in the Punjab and the Indo-Gangetic valley generally.[1]

Figs. 9 and 10 shows that the two areas of *Heaviest Rainfall* in India are:—

(I) the western slopes of the Western Ghats mountains (including Konkan, Malabar and south Kanara),

(II) the southern slopes of the Assam hills (including Manipur and Tripura) and the eastern Himalayas The rainfall here is more than 255 cm. annually.

The two areas of the *Scantiest Rainfall* are:—

(I) the Thar and Sind and

(II) a small part of Orissa. The annual rainfall here is less than 25.5 cms.

Over the rest of the country the rainfall generally varies from 50 cms to 200 cms The areas near the coast and those near the Himalayas have more rainfall than areas away from these two locations However, according to the observations of the Census Commissioner, 11 per cent of the total area gets rainfall above 187 5 cms , 21% between 37.5 cms. and 125 & 187 cms., 37% between 75 & 125 cms , 24% between 37.5 and 75 cms. and 7% below 37 5 cms.

The annual rainfall of India is 105 cms *i.e.*, we get all over one lakh maunds of water on every acre of land. The variations from this normal is as great as +30 cms. and —20 cms. as occurred in 1917 and 1899 respectively

1 The following table gives the annual distribution of rainfall according to different seasons —

Rainfall Season	Duration	Percentage to the annual rainfall
South-West monsoon ..	June-September ..	75·0
Post-monsoon ..	October-November ..	13·0
Winter or North-East monsoon	December-February ..	2·0
Pre-monsoon ..	March-May ..	10 0
	Total ..	100·0

(From *Agricultural Situation in India.*)

The following map shows that large areas in India and Pakistan are subject to a considerable variability of rainfall. The map shows that places with lower average rainfall have higher variability. Thus Naushehra, in Sind, with a mean annual rainfall of 12.5 cms. has a variability of 53 per cent. But Kanpur whose annual average is 85 cms, has a variability of

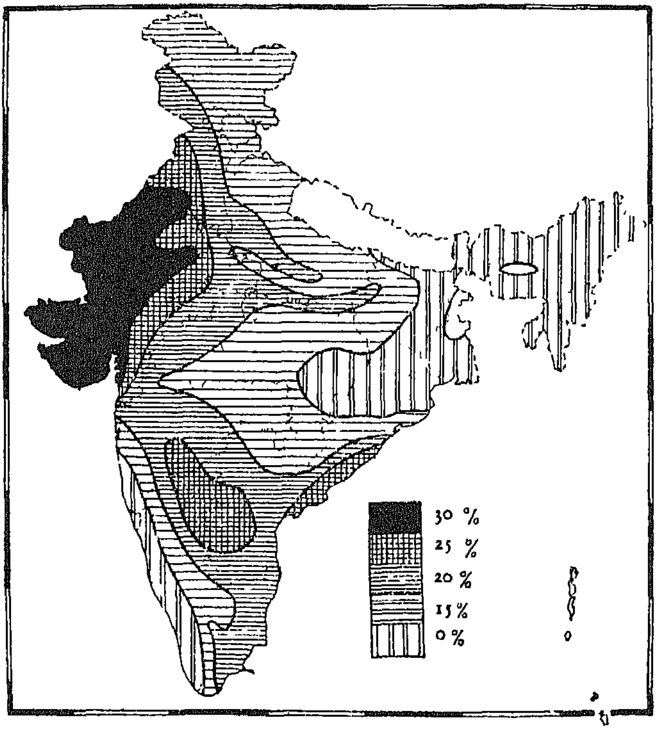

Fig 11. Variability of Rainfall in India.

20 per cent only Calcutta, with its 162.5 cms. has only 11 per cent variability The high variability in areas of low rainfall is, however, not such a serious menace to agriculture as the comparatively low variability in areas which have just enough rainfall for agricultural purposes Any decrease in rainfall in such areas makes it impossible for agricultural operations to be carried on and a famine is the result

The failures or variability of rain is not minded either by areas of heaviest rainfall or by areas of lowest rainfall. In areas of heaviest rain, there is always enough water available for the

growing of some crops In the dry areas, there is provision of a network of canals for irrigation that enable the crops to be grown But other areas are hit severely. Such areas lie in the central part of the country, receiving from 75 cms. to 125 cms of rainfall in normal years. This is the *Famine Zone* of India. In this area there is not enough rain for crops during normal years, so that adequate provision of irrigation facilities does not exist. This fact is the source of considerable suffering in times of drought.

In a very general way, it may be said that the climate of India is a Monsoon climate; having land winds blowing in winter and the early summer, and oceanic winds blowing in late summer. The late summer is, consequently, the *Rainy Season.* The rain-giving monsoon is known as the S-W Monsoon. It is divided into two branches, the Arabian Sea branch and the Bay of Bengal branch, because of the shape of the peninsula. The Bay of Bengal branch is forced into the interior of the country by the particular type of relief features These features are the general direction of the mountains which almost confine the monsoon in India, and the river valleys like the Ganga Valley and the Mahanadi Valley up to which the cyclones from the Bay of Bengal move. These cyclones are formed, because of the junction of the continental air of India and the oceanic air of the Bay of Bengal They have a very great influence on the distribution of rainfall in India The Arabian Sea branch of the S-W Monsoon practically exhausts itself against the Western Ghats. Its influence on the general distribution of rainfall in India is nominal.

The rainfall distribution in India is marked by a region of heavy rainfall along the windward slopes of mountains where the rainfall is more than 255 cms It is also marked by a north-south running belt of moderate rainfall of 75 to 100 cms per year occupying the central part of the country. To the east of this belt up to the mountains the rainfall is about 125 to 150 cms. To the west of the belt the rainfall is less than 75 cms, except along the Western Ghats. The deserts of Thar and Rajasthan have less than five cms of rain The importance of the winter cyclones for rain is also to be noted. Famines are an inborn character of Indian rainfall.

The temperature distribution in India is primarily the function of the latitude The Tropic of Cancer passes through India. Low temperatures do not occur, as a rule, here except in winter in the Himalayas. There is also distinction between the temperatures of the Peninsular region and those of the Northern parts. In winter, the temperatures in Northern India are about 15.5°C.

In the peninsular region, they are above 23 8°C In summer, the temperatures in the north are very high in the early part, but they come down to about 32 2°C after the rains start. In the South the summer temperatures are about 32 2°C The character of the night temperatures is a distinctive feature in the plateau region of the South Even in summer, the nights are cool and breezy on the plateau

MONSOON FORECASTS

The strength of the summer monsoons in India depends on four factors. These are —

(i) *The amount of snow that has accumulated in the Himalayas* by the end of May If this amount is large, the monsoon tends to be weak, specially in the North-western part of the country.

(ii) *The air pressure in Mauritius* in the month of May, which typifies the air pressure over the Indian ocean If this pressure is high, the monsoon is weak. For it tends to create anticyclonic conditions in India.

(iii) *The Rainfall in East Africa and in Zanzibar* during April and May which is an index of the air currents in the Equatorial doldrums. If this rainfall is high, the Indian monsoon is weak. For high rainfall in the doldrums can result only when the convectional currents of air are considerable. Such currents retard the flow of air from the Southern Indian Ocean into India.

(iv) *The air pressure in Chile* in South America during the months of March, April and May If this pressure is high, the Indian monsoon is good For it tends to create low pressure in the Indian Ocean and so the cyclonic conditions in India.

EFFECT ON ECONOMIC LIFE

India's climate has several important features that affect her economic life.

(i) The temperatures are never too low in winter in any part of India This gives a long growing period, especially as the frost is practically unknown, except locally now and then This feature enables India to grow temperate land crops during winter and tropical and sub-tropical crops during summer In fact, but for the two driest months, May and June, the whole year is the growing season in India. In Bengal, Assam and the Peninsular

region, wherever water is available for irrigation even in these dry months crops are grown in the fields Thus, as many as three crops of rice can be grown in one year in these parts.

(ii) The largest amount of rain comes during the three summer months, June, July and August This is utilised for the quick maturing food crops like millets and maize, etc The hot and moist climate of this period produces an abundant vegetative growth in the plants which is useful in providing plenty of fodder for cattle.

(iii) The summer temperatures are high and rise suddenly The maturity of crops in India is, therefore, rapid. This rapid maturity of crops tends to deteriorate their quality. India is, therefore, not a 'quality' producer, but only a 'quantity' producer. This applies to winter crops as well as summer crops. For the harvesting period of both occurs during summer.

(iv) The concentration of rainfall to a few months in the year leaves the greater part of the year as dry. This does not encourage the growth of grasslands in India. Whatever grass grows during the rains is scorched during the dry season Pasturage is therefore, poor in India. Cattle and other stock have to be stall-fed.

(v) The geographical distribution of rain in India is such that areas of fertile alluvial soil (in the Punjab and U P) where the winter temperatures are cool enough for temperate land crops, get only a moderate amount of rain, about 75 cms. This enables them to grow a large amount of wheat

(vi) The huge rainfall, coming immediately after the country has experienced great heat of summer, breeds many disease germs. Malaria, dysentery and a host of other diseases afflict the population during and after the rains This saps the vitality of the people living in the wetter parts of the country and makes them inefficient and easy-going. The loss in efficiency due to diseases has not been less than 20 per cent. The fatigue and the ill-defined general conditions of debility, produce a disinclination to hard work

(vii) The hot and moist climate of the summer months not only tells on our health, but also tends to make us easy-going. In contrast, the people in the temperate lands are forced to be active physically to keep them warm This climatic drawback makes labour in India inefficient. This drawback, however, does not affect all parts of India to the same degree. The Punjabi, brought up in a dry climate, is entirely different from the Bengali living in a hot and moist climate.

(viii) The frequent failures of rain and the attendant misery and starvation facing millions engaged in agriculture have tend-

ed to make people superstitious They easily lose heart and feel helpless against 'Fate'.

(ix) Climate exerts a great influence on agriculture As the incomes of agriculturists fall (because of failure of rains, floods, etc), their capacity to buy industrial goods and services is dimi nished. Lawyers, doctors and professional men find their incomes reduced. Failure of crops reduces railway earnings and affects the volume of exports Rent cannot be collected and land revenue falls into arrears It has, therefore, been rightly said that, "Budget" making in India is a gambling in rains

QUESTIONS

1 What do you understand by Monsoon Climate and on what factors does it depend ?

2 Why is the study of the climate of India necessary for understanding its economic geography?

3 Discuss the pressure conditions in South-eastern Asia in May What is their effect on the weather conditions of India?

4 What are the characteristics of Indian rainfall? Discuss them in detail

5 What is the significance of winter cyclones in Indian climate ?

6 Why is the distribution of rainfall all over India not uniform ?

7. It is said that the Indian Budget is a "Gamble in Monsoon." Do you agree with this statement? why?

8 What causes affect the distribution of temperature in India during (a) the Winter and (b) the Summer?

9 Describe the factors that enter into the forecasts of Indian Monsoons.

Chapter 3

Vegetation

There is a great variety in the natural vegetation of India Considering the great variations in climate and physical features of the country, this is to be expected. Tropical, Sub-tropical, Temperate and Alpine, all classes of vegetation occur in this country.

TROPICAL VEGETATION

Over the greater part of the country, however, it is the tropical vegetation that is found Ordinarily, in other parts of the world, tropical vegetation is subdivided on a basis of moisture conditions into the following types:—

(a) Evergreen forest, (b) Deciduous forest; (c) Savannah; (d) Thorn forest; and (e) Steppe

In India, however, according to Champion,[1] examples of well-defined tropical grasslands are lacking; though grassland is common enough as a secondary and a temporary phase of development under the influence of forest fire or grazing. The typical savannah type of other countries is also absent, as the closed deciduous forests here grade into thorn forest without any open grassy park-like stage

SUB-TROPICAL VEGETATION

The Sub-tropical, Temperate or Alpine vegetation is found in India only on the mountains The sub-tropical conditions seem to be determined more by altitude than by latitude here and are characteristically developed in the hilly tracts The sub-tropical Zone is really a transition from the tropical to the temperate Zone, and is sometimes, difficult to be distinguished. Owing to a moderate summer monsoon rainfall, it seems quite well defined in the West and Central Himalayas as the Chir Pine Forest. In the north-west also where the rainfall is low and comes mostly in winter, there is a sub-tropical dry evergreen forest. Even in the Eastern Himalayas where there is a heavier summer rainfall, the sub-tropical belt of forest occurs between the tropical vegetation and the temperate oak forests. But on the

1 Champion, *A Preliminary Survey of the Forest Types of India and Burma*, 1936.

hills of South India there seems to be no real break between the tropical and the temperate types; only a falling off in the luxuriance of forest being noticed The small daily and seasonal range of temperature is evidently the cause of this there

TEMPERATE VEGETATION

The temperate vegetation in India consists only of forests on mountains There are no temperate grasslands in this country, as India does not extend into middle latitudes

The Temperate forest in India are distinguishable in three classes Two of them are mainly coniferous, while the third is predominantly broad-leaved These classes depend mostly upon the rainfall during the season of vegetative activity, *i e.* the summer months with a mean temperature over 11° C The wettest type, which is the broad-leaf type, occurs both in the southern and the northern hills, but the moist and dry types, which are coniferous, occur only in the Himalayas.

ALPINE VEGETATION

The Alpine vegetation is found in India only in the Himalayas and the connected ranges Above the timber limit, high forest is replaced by Alpine scrub, varying in form with the available moisture supply The birch and the rhododendron are the commonest trees in the Alpine forests in the Himalayas. The forest is mainly evergreen, although several of the broad-leaved varieties are deciduous. These forests occur at altitudes of 2900 to 3500 metres.

VEGETATION OF THE PLAINS

The natural soil covering of the plains in India is a closed forest But very large areas in the plains are found to be almost, or quite, devoid of trees They support only a meagre covering of grass It is extremely probable that clearings for human habitation and agriculture are responsible partly for this There is, however, another way in which closed forests can be destroyed and replaced by grass Owing to the alluvial nature of the soil in the plains, the rivers continually swing backwards and forwards in their courses It often happens that as a result of heavy rainfall in the hills, these rivers rise rapidly and carry down enormous quantities of clay and silt Should it happen that the flood is of exceptional duration and volume, the rivers spread their waters over a large area When this happens in evergreen forests, a deposit of clay and silt is laid down which ultimately leads to the decay of the forests In the following year, in the evergreen forests, most of the tall trees and shrubs

die out, owing to the clay deposit The trees that are left soon disappear, owing to the attacks of fungi and insects. This phenomenon is quite common and is responsible for the destruction of the forest cover over large areas in the plains, close to the foot hills.

Overgrazing and forest fires lead also to the destruction of natural forests. The forest fires in India are most destructive during the cool weather when the grass is not wet and when the atmosphere is dry. During the summer months the grass underbush withers, while it is soaked during the rainy season and cannot, therefore, carry the fire.

JHUMING

The influence of man in the destruction of forests is most serious. Apart from the reckless cutting that is common to all parts of the world, Indian forests in Assam suffer from the practice of '*Jhuming*' which the backward tribes follow to clear the ground for cultivation. *Jhuming* is practised only between certain altitudes There is no *Jhuming* above 2438 metres 8,000 ft (2438 metres), for the reason that crops will not ripen so high Below 1523 metres, the hill people do not go, for fear of heat and disease The south-east, south, or south-west aspects are usually chosen in order to take advantage of the sun's rays, and all trees, even the largest are cut down in the cold weather During the hot weather, the debris is set fire to at the lowest part of the Jhuming, the rising flames cause an upward draught and the fire rushes up the hill When all is over, nothing is left but the charred and blackened trunks of the largest trees As soon as the embers have cooled down, various seeds, such as rice, millet, pumpkins, etc are dribbled into the earth with the ashes The field is weeded once or twice during the rains before the crop is harvested Next year and the following year the field is cultivated and then when the accumulated fertility of the soil has become exhausted, mainly through exposure and erosion, the area is abandoned. A distinctive shrubby vegetation then takes possession of the land, or it may be covered with a weed In areas where there is a real land hunger, the "Jhumias" return at shorter intervals to the same field and the inevitable result is that the area does not get a chance to become covered with tree at all

FOREST TYPES

Broadly speaking Indian forests may be divided into the following main types[1]—

1 *Arid Forests.* These forests extend over a considerable portion of Rajasthan, and the south of the Punjab, in dry tracts

1 Troup, *The Work of the Forest Department in India.*

where the rainfall is less than twenty inches. The number of species in this forest is few; the most important tree being the *babul* or *kikar* which, however, in the driest regions exists only by the aid of river inundations.

2 *Deciduous Forests*. Most of the trees in this type are leafless for a portion of the year This type of forest loses its leaves at the beginning of the hot season, when fire normally runs through it and burns the grass layer which is the usual soil covering. The layer of fine soil increases the clay content which increases its water-holding capacity. The species which cannot tolerate the early dry conditions which are common in the deciduous forests thus make their appearance These forests, which extend over large areas in the sub-Himalayan tract and the Indian Peninsula, are among the most important. They

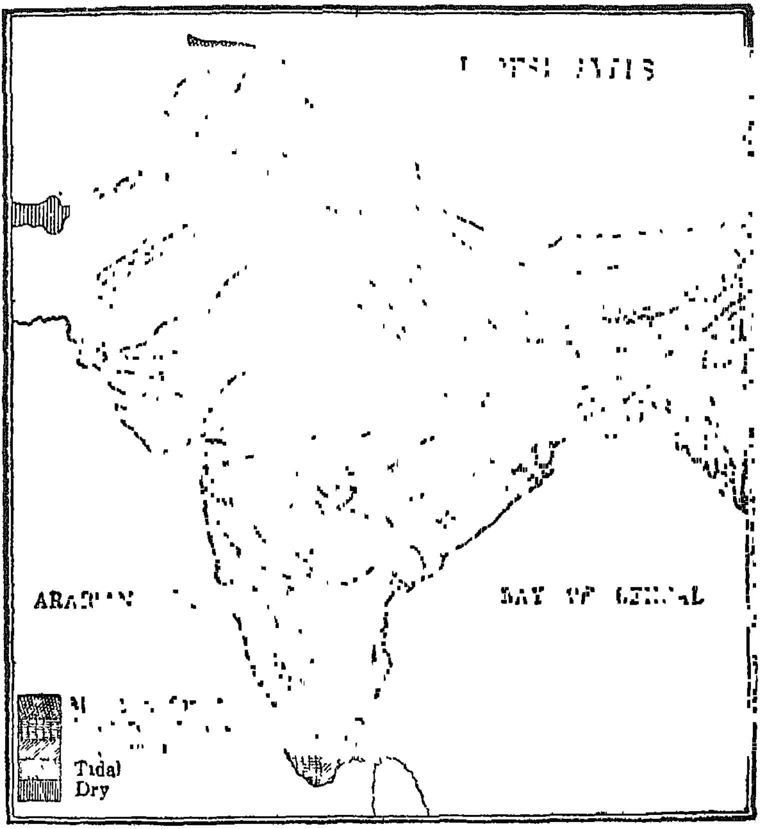

Fig. 12.

comprise the greater part of the *Teak* and the *Sal* forests of India. Ebony, rose-wood, sandal wood, Indian Poduk and a great variety of other valuable trees are also found in these forests. These forests are also known as the monsoon forests the chief features of which is that there is lack of grass and shrubs in dry season.

3. *Evergreen Forests.* These forests occur in regions of very heavy rainfall, such as the west coast of the Peninsula and the eastern sub-Himalayan tract and the Andamans They are characterised by the great variety and luxuriance of their vegetation Some of the trees in these forests grow to a height of 150 ft. (46 metres) or more with a dense canopy on top The undergrowth is often a tangle of canes, creeping bamboo and palms, fern which may replace high forest along streams Such forests are available in Nilgiris and Annamalai hills up to the height of 4,000 ft. (1219 metres). They are also known as *Shola Forests.*

4. *Mountain Forests* As has been noticed above, mountain forests vary from the sub-tropical through temperate to Alpine forests, according to elevation and rainfall In the Eastern Himalayas and Assam these forests are characterised by various kinds of oaks, magnolias and laurels In Assam '*Khasia pine*' grows abundantly at elevation of 3,000 to 7,000 ft (915 to 2134 metres). In the North-Western Himalayas, the chief timber tree is the *Deodar* which occurs most ommonly at elevations of 6,000 to 8,000 ft (1829 to 2438 metres). The *Deodar* also occurs in association with oaks or blue pine Towards its upper limit the *Deodar* merges into *spruce* and *silver fir*, while below it are found extensive forests of *chir pine* which is tapped for resin

5. *Tidal Forests.* The Tidal forests occur on the northern sea-coasts of Madras and along tidal creeks, except on the west coast. The most characteristic trees belong to the mangrove family. The forests that are inundated at high tides by the brackish sea water are important for the valuable Sundri tree. In the delta of the Ganga there are fresh water forests and salt water forests. The fresh water forests occupy the levels which are flooded for some time each day The flood water is never very salty During the rainy season, the flood water is almost entirely fresh This forest is best developed on the ground lying between the drier banks and the 'bils' in the Sundarbans Tidal forests occur to a small extent also in the deltas of the rivers on the east coast

FORESTRY IN INDIA

If we leave out three countries, Russia, U S A. and Canada which are very largely forested, India has the largest area under

forests. The following table compares the forest area of some important countries of the world:—

*Forest Area in Some Important Countries**

Countries	Forest Area (million Hectares)	Percentage to Total land area	Forest area per Capita
U S S R.	742 6	33.9	3.5
U S. A.	252.5	32.8	1.8
Brazil	480.2	56 7	8.6
Africa	801 6	27 0	4.0
Japan	22 6	61 8	0.3
France	11.4	20.7	0.3
Italy	5 6	19.2	0.12
W Germany	6 7	28.1	0 14
U K .	1 6	6 5	0 03
Sweden	23.0	56.0	3.2
Finland	21.7	70 9	5 3
Spain	12.6	25.2	
India	73.3	22 3	0.2
Indonesia	121 0	63 5	1 6

* Source *Unasylva, An International Review of Forestry and Forest Products.* September, F.A O.

The following table gives the distribution of forests in different states of India :—

Forest Area (in sq. miles)

(1957-58)

State	Area	% of forest area to total area
Andhra	24,300	22·9
Assam . .	17,700	38·4
Bengal (West) ..	4,700	13·8
Bihar	12,900	16·9
Jammu and Kashmir ..	8,100	9·4
Kerala .. .	3,500	23·3
Madhya Pradesh .	66,700	39 0
Madras	0,200	16 4
Maharashtra and Gujrat	30,500	15 9
Mysore .	13,500	18 2
Orissa	24,600	41·0
Punjab	5,400	11 4
Rajasthan	1,7000	12 8
U P ..	1,3000	11·5
Total India .	16,4000	

*There is some area which is yet to be accounted for.

Forest Area (in 000 Acres)

States			Area	Percentage of forest area to total area
Andhra	..	..	13,992	18.2
Assam			12,042	42.2
Bihar	..	..	9,676	19 5
Bombay	..	.	15,946	12 5
Kerala	.	.	2,433	22.2
Madhya Pradesh		.	33,489	30 8
Madras	..	..	4,488	12 9
Mysore	.	.	6,288	13 3
Orissa	.		8,799	26 3
Punjab	..	.	843	2.6
Rajasthan		..	3,478	3 6
U. P		.	8,713	11 1
West Bengal	.	..	1,916	9.1
J & K	..	..	1,398	22.2
Total India		.	125,554	22 3

India's forests cover an area of 2 74 lakh sq miles, *i.e.*, about 22 per cent of the total geographical area Compared with the forest areas in most other countries this is a low proportion.[1] Not only is the forest area proportionately smaller in India but it is also unevenly distributed and the productivity per acre per annum is 2.5 cft, which is substantially below the average yield of

1. The per capita forest area is 3 5 hectares in the U S S R, 1 8 hectares in the U S A. and only 0 2 hectares in India (1 hectare=2 471 acres).

forests in other countries such as France, 56.8 cft, Japan 37 0 cft., and U.S A., 18.0 cft Hence, the National Forest Policy Resolution of May 12, 1952, suggested that at least a third of the total area should be under forest, the proportion being 60% in the Himalayas, Deccan and other mountainous tract and 20% in the plains.

The area under forests in India is shown in the following table

AREA UNDER FORESTS IN INDIA

(In square miles)

Classification of Forests	1950-51	1955-56	1957-58
1. (a) Exploitable	2,25,714	2,18,122	2,14,886
(b) Inaccessible	51,518	53,562	59 528
Total	2,77,232	2,71,684	2,74,414
2. (a) Reserved	1,32,975	1,38,791	1,31,586
(b) Protected	45,532	65,067	93,759
(c) Unclassified	98,725	65,730	49,066
Total	2,77,232	2,71,684	2,74,411
3. (a) Coniferous	10,017	9,736	10,041
(b) Broad leaved			
(i) Sal	40,747	41,849	38,756
(ii) Teak	16,784	22,445	19,205
(iii) Miscellaneous	2,05,684	1,95,558	2,06,409
Total	2,77,232	2,71,684	2,74,411

The significance of India's forests, however, does not lie so much in the area, as in the fact that Indian forests produce some important products which are of great economic importance and which are not produced in other countries of the world. The essential oils and shellac are the products of Indian forests only.

Of 2,74, 414 sq miles of forest area, 2,14,886 sq. miles are merchantable and 59,528 sq miles inaccessible. Forest area in India is by no means large when the vast population of the country is considered To make the position worse a very large proportion of our forests is inaccessible for effective development and exploitation. For example, the vast forest resources of the Himalayas or of the Sunderbans cannot be tapped for want of good means of communication It must be remembered that the major product of the forest is timber which is a bulky and heavy commodity, and cannot be economically exploited without good transport In some of the countries of Europe and America easy and cheap method of transport is provided by the winter snow which, hardening into ice, provides a slippery road for the logs The logs are dragged to the river (which itself is frozen at the time), and floated down when the snow melts Nature has not bestowed this advantage on us The extraction and transport of our forest produce, particularly timber, is often attended with much difficulty in India and may involve engineering problems demanding a high degree of technical skill where the transport of timber is involved.

The methods of transport used in forest exploitation in India vary greatly according to local conditions, but fall naturally under the two main heads of land and water transport Under land transport the following are common:—

(a) *Human Transport* This includes, (i) the removal by head loads or otherwise fuel, etc for short distances; (ii) the carriage of sleepers in the Himalayas from the forests down to slides or floating streams and (iii) the extraction of heavy logs in the same localities with the help of rolling roads and slippery earth slides.

(b) *Animal Transport.* This includes the carriage of produce by carts where suitable roads exist or by pack animals such as the employment of elephants to drag heavy timber to floating streams, as in Mysore and the Andamans Buffaloes are also used for this purpose and are cheaper than the elephants.

(c) *Mechanical Transport* This includes tramways, rope-ways and skidders Some of the most important forest tramways in India are those in Goalpara Division in Assam Ropeways,

worked principally by gravity, are used in various parts of the Himalayas (especially in the Changamanga area of the Punjab).

Transport by water includes wet slides to points from where sleepers can be floated. telescopic floating in small streams where there is not enough water, and ordinary floating, rafting and conveyance by boats. Water transport is used mostly in the Sunderbans and in Assam

Causes of Slow Progress

While inaccessibility of our forests and backward transport are no doubt, causes of the slow progress of forest exploitation in India, it must not be lost sight of that the demand for timber in India is not as great as in some of the industrialised countries of the West In Europe and in America whole houses, from the roof down to the floor are built entirely of timber. Our climate will not permit this. Planks are liable to crack in the scorching heat—even the small quantity of timber we use in our houses needs constant care. Besides, the rat and the insects considerably shorten the life of ordinary timber in India We do not use as much furniture as the people in colder countries do. Our demands of timber are, therefore, less on this account also.[1]

Another difficulty, apart from inaccessibility and lack of demand for timber, in forest exploitation here is that very few types in Indian forests are gregarious to enable economic exploitation Most of our timber trees (as for example Teak), grow mixed with other varieties which have no commercial importance They do not occur in large stands This involves a good deal of waste in exploitation and makes it very expensive in spite of the cheap labour available in India. We have very little pulping wood in our forests Whatever pulping wood we have, occurs at great heights in the Himalayas where access is difficult This is unfortunate for we cannot make use of this wood for making pulp for which there is a great demand. We must import the pulp from foreign countries, therefore

Inaccessibility of forests, mixed growth of trees, lack of pulping wood and lack of a large market due to industrial backwardness of the country are the main drawbacks under which forest exploitation in India suffers.

FOREST PRODUCE

Forest produce in India is classed under two heads—major produce, i.e., timber; and minor produce, i.e., miscellaneous by-products or secondary products like grass, nuts fibre or resin, etc.

1 For example, India's per capita consumption of round wood is 1 4 cu ft as compared with the U S A 58 cu ft The consumption of pulp products is 1.6 lbs as against 78 lbs. in the U K

Value of Forest Produce (In Crores of Rs.)

Year	Major	Minor	Total
1948-49	14 10	4 96	19 06
1949-50	17 16	5 68	22 84
1950-51	19 08	6.92	26 00
1951-52	19 76	7 06	26.82
1952-53	17 53	5 97	23 50
1953-54	17 45	6 30	23 75
1954-55	21 67	7 73	29.40
1955-56	24.46	8 01	32.47
1957-58	28 93	8 51	37.47

There is a large number of trees growing in Indian forests which produce good timber. The varieties that are commercially exploited, however, are limited The most important varieties of trees that are at present exploited are the following.—

1 *Himalayan Silver Firs.* They are found in the north-western part and also in the eastern parts of the Himalayas at elevation from 7,500 to 10,000 ft. (2286 to 3048 metres). These trees are tall evergreen conifers, with soft white, not very durable, wood suitable for planking, packing cases, wood pulp and matches They are at present worked to a small extent, though the quantity available is very large. They are more or less inaccessible at present

2 *Deodar.* This is one of the most important timbers of India It is a very large evergreen coniferous tree; a height of 90 to 120 ft (28 to 37 metres) being usual It grows in the Himalayas at elevations of 5,500 ft to 8,000 ft (1676 to 2438 metres) from Garhwal westwards through Jaunsar, the Punjab Hills, and Kashmir, between the outer wet ranges and the inner dry zones. The deodar forests avoid outer ranges and regions of high monsoon rainfall They extend to an appreciably lower height on cool aspect But on sunny ridges, they attain a greater height The forest is nearly typically pure deodar, only a little spruce, and blue pine also being found The workable area of

deodar forest in the north-western Himalayas is about 2,000 sq. miles (3219 kilometers), but as in the case of the silver fir forests, the greater part of the deodar zone lies mainly in the Punjab. The deodar wood is yellowish brown, moderately hard, oily, strongly scented and very durable It is used largely by the Indian railways for various purposes

3. *Blue Pine* is another important conifer in India It grows along the whole length of the Himalayas from Chumbi Valley in Tibet eastward It grows at elevations of 6,000 to 12,000 ft (1829 to 3658 metres) Pure stands of blue pine are commoner at the upper and lower limits than in the central part where mixed conifers predominate. Its wood is pink, moderately hard and of good quality. Its workable area is not large, though it is gradually coming into prominence. Most of the workings are in the Punjab.

4 *Chir.* The chir is another large size conifer growing to a height of 60 to 100 ft (18 to 30 metres) It occurs in the Himalayas from Bhutan westwards at elevations of 3,000 to 6,000 feet (914 to 1829 metres) The chir forest overlaps the tropical deciduous forest at the lower elevations, while it gives way to the temperate forest above It is extensively developed in Kashmir, Punjab, U.P and Nepal The absence of the chir forest on the southern face of the outer range of the Himalayas is noteworthy, and is due to the combination of excessive heat with heavy monsoon rainfall. The chir wood is light reddish brown, and moderately hard. It is used largely for making tea boxes. The workable area of the chir pine is about 3,000 sq miles (4828 sq kilometres) fairly equally divided between the Punjab and U P The chir is now extensively tapped in *U P*, and the Punjab for the manufacture of resin and turpentine

5 *Sal.* The sal tree is another important timber tree which has come into prominence, due to its large use for railway sleepers The sal forests occur largely in the vicinity of the Ganga Valley which has the largest network of railways in India It is, therefore, an added advantage for the exploitation of the Sal forests, as the railways can pay higher prices than building and other trades for the sal sleepers The sal is a large gregarious tree found in Northern and Central India, in the Sub-Himalayan tract from Kangra to the Darrang and Nowgong districts of Assam and in the Garo Hills. It grows also in Chhota Nagpur, Orissa and the Madhya Pradesh Sal wood is brown, hard and very durable, though somewhat coarse and cross-grained which seasons slowly The working area of the sal forests in U P alone is about 3,000 sq miles (4828 sq. kilometres) of which only a third is valuable, the rest being covered with inferior trees The sal forests of U P. which alone are

exploited to any extent, are divided into three classes· the hill forests, the bhabar forests, and the terai and the plain forest. Of these, the finest are the bhabar forests. Outside U P , good quality sal is found in Chhota Nagpur only.

6. *Teak.* The teak forests provided the most important timber in India when the Burmese forests were considered as Indian forests. Now, of course, its importance has gone, because the teak forests found in the present boundaries of India are not so fine as the Burmese teak forests Teak forests occur mostly on the Western Ghats, Nilgiris and in Madhya Pradesh Teak occurs either alone or mixed with other species Pure forests of teak are generally found on the lower slopes of the hills, or on alluvial flat along the banks of rivers; or at the bottom of ravines On the higher slopes of hills, teak occurs mixed with other trees in the forest The most important areas producing teak are in the districts of Hoshangabad and Chanda in Madhya Pradesh and Kanara and Khandesh in Bombay State. Teak forests are not found north of the Narbada river, nor east of the Mahanadi There is a small export of teak wood from the Western Ghat area. Because of the high price that teak timber fetches, it has been planted in India more extensively than any other single species The existing teak plantations in India are now estimated to cover an area of about 300 sq miles (483 sq kilometres).

7 *Babul (Acacia) and Shisham* which occur scattered over large areas in the drier parts of the country provide good timber for local use

MINOR PRODUCE

The importance of Indian forests lies in the exploitation of minor produce, some items of which are in demand all over the world. The importance of our minor forest produce is not so much in the present stage of development as in its future possibilities Bamboos, some of the grasses, oils, and tanning materials produced in our forests are capable of providing inexhaustible supplies of industrial raw materials Unlike timber, new supplies of these raw materials are quickly brought into existence The following table shows the value of minor forest produce for 1957-58.

Value of Minor Produce (in lakhs of rupees)

Bamboos and canes	134 6
Fibres and flosses	0.8
Gums and resins	125 6
Other Minor Products	593 2
Total	854 2

The Indian forests are so rich in minor produce of all kinds that it is possible to refer only to those which are or are likely to be of commercial value. Among the more important ones are comprised bamboos, grass, leaves for fodder and *biris*, fibres and flosses, oilseeds, tans and dyes, oils, gums, resin, rubber, drugs, and spices, etc Most of these minor products are produced abundantly in the forests of Peninsular India. Himalayan forests are important mostly for their timber and resins. Bamboos grow extensively in all the forests except in the driest parts, the wetter the country the more luxurious is the bamboo growth. Among oilseeds, the mahua seed is the most important By far the largest proportion of mahua is found in the Madhya Pradesh and Bombay. Among the gums may be mentioned the lac which is produced mostly in the Chhota Nagpur region. Among oils, the Sandal oil is the most important It is produced mostly in Mysore Among the tanning materials are the myrobalans (*harra*) and the bark of several species of trees, especially the babul (Acacia) tree The importance of these tanning materials will increase considerably if extracts could be made from them, as is done with the quebracho tree in South America

During 1954-55 the total produce of timber and fuel amounted to a little 15,82,00 thousand cubic feet valued at Rs 21,67,84 thousand The minor produce during the same period fetched 7,73,87,000 rupees

During 1957-58 the outturn of major forest produce was as follows —

Timber	Quantity in (lakh Cu. ft)
Timber	1332 3
Round wood	296 5
Pulp match wood	19 7
Fire wood	8601·9
Charcoal	273 8
Total	5524 4

The total value of major forest produce in 1957-58 was Rs 2893 3 lakhs.

The main importance of the forest in India is, however, as a source of grazing and fuelwood that it provides. India is a country where there are no grasslands to provide grazing to animals. Forests are, therefore, a great help for keeping animals.

India does not use much coal as a domestic fuel. Wood fuel is, therefore, a great necessity. Forest is fundamental in Indian economy; more than in any European country, on this account.

ADMINISTRATIVE CLASSIFICATION

With a view to better exploitation and protection against destruction, the Indian forests have been classed under (i) Reserved, (ii) Protected, and (iii) Unclassed forest[1] The Government of India is paying attention to the systematic development of Indian forests, and apart from the usual administrative machinery for protecting and working the forests, there is a Forest Research Institute at Dehra Dun to tackle scientific problems dealing with Indian forests

Realising the usefulness of forests in checking soil erosion, the Government has planted new forests in some of the ravine lands of the Chambal and the Jumna Under the 3rd Plan a long-term plan to extend the area under forests has been formulated The following measures are envisaged:—

(i) The rehabilitation of about 4.0 lakh acres of 'degraded' forest which have come under State control

(ii) Plantation along canal banks and roadsides and on village wastelands as shelter belts

(iii) Plantations of commercially important species like *teak* as forest land, of *wattle* and *blue-gum* on about 13,000 acres and of medicinal plants on about 2000 acres

(iv) match-wood plantations on about 50,000 acres;

(v) Construction or improvement of 12,000 kms of forest roads;

(vi) The establishment of timber treating and seasoning plants,

(vii) The survey of forest resources and adoption of better techniques of timber extraction. A forest Research Centre has been set up at Bangalore

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1 Classification of forests by status and type (in 1957—58) —

A By status:

Reserved forests	131,586	sq miles
Protected forests	93,759	,, ,,
Unclassed forests	49,066	,, ,,

B. By Types.

Merchantable	214,886	sq. miles
Unprofitable or Inaccessible	59,528	,, ,,

(viii) Plantations of commercially important species like *teak* as 50,000 acres of forest land of wattle and *blue-gum* on about 13,000 acres and of medicinal plants on about 2,000 acres.

Van Mahotsava was inaugurated in 1950 with the object of making the people conscious of the value of trees in the country's economy During the first three years of the Van Mahotsava about 12 crore trees were planted by the people, of which about 60% have survived.

Schemes have also been prepared for the immobilization of the Kutch desert and the afforestation of the U P and Rajasthan deserts It has been proposed to create a green belt on the western border of Rajasthan about 55 kilometres long and 7 kilometres wide

Extraction of Andaman timber is now being increasingly done to meet home and foreign demands

QUESTIONS

1 What are the characteristics of Indian forests? How far are geographical factors responsible for them?

2 What factors lead to the growth of grass at the expense of forests in India?

3 What are the causes of the disappearance of the closed forests from the plains in India?

4 What are the main forest types in India? Where do they occur?

5 What is the main forest produce in India? What are the main areas of production?

6 What is the importance of minor produce in Indian forests? Where is the produce mostly found?

7 What are the drawbacks in the way of forest exploitation in India?

8. What is the importance of Sal and Deodar forests in India?

Chapter 4

Soils

The dependence of the bulk of our population is on agriculture, and therefore, study of Indian soils is of great interest. Unfortunately, very little systematic work has been done in the study of Indian soils The data available, therefore, are meagre.

The effect of the rock as well as of the climate on soils in general is clear. Wadia[1] and others have made an outline study of the influence of geology on Indian soils.

The Indian Council of Agricultural Research is tackling the study on the basis of climate The Council has come to a tentative conclusion that according to the influence of rainfall the soil zones of India run north-south. It cannot, however, account, on the basis of climate, for the fact that certain soils assimilate the fertilizers much more quickly than others

The Indian Agricultural Research Institute, Delhi, divides the soils of India into the following main classes[2] —

(1) Alluvial, (2) coarse alluvial, (3) red soil lying on metamorphic rocks, (4) laterite soils, (5) black soils, (6) deep black soils, (7) light soils on trap rocks and (8) deep black alluvial soils.

The alluvial soils of Northern India are further subdivided into (i) Indus alluvial, (ii) Ganges alluvial and (iii) Brahmaputra alluvial soils.

The soils of India offer a distinct contrast to those of many other countries, inasmuch as they are very old, fully matured, and do not in many cases show pedogenic processes and the close relationship between the soil and its rocky substratum. The weathered materials in most cases have been transported to great distances by various agencies The majority of the soils

1 Wadia · "Soils of India" Records of the Geological Survey of India, February, 1935

2 The I C A R in its All-India Soil Survey Report, 1953, divides Indian soils into the following groups

(i) Red Soils, (ii) Laterite Soils, (iii) Black Soil including Black Cotton Soils, (iv) Alluvial Soils, (v) Forest and hill Soils, (vi) Saline and alkaline Soils, and (vii) Peaty and Marshy Soils

in India are of ancient alluvial origin. Their examination shows that although the nature and composition reflect to some extent the composition of the original rocks from which they are derived, they are the result to a considerable extent of the climate, particularly the amount and seasonal distribution of rainfall The monsoon rainfall and the high temperatures that

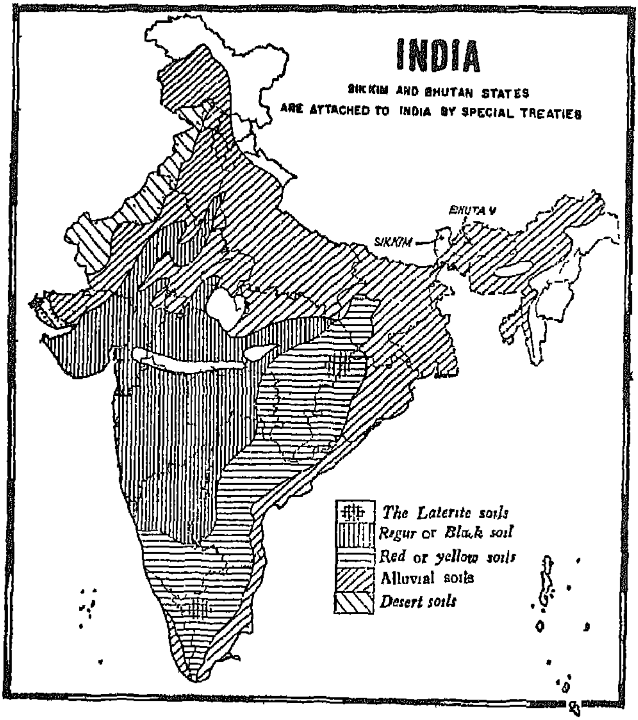

Fig. 13 Soils of India

prevail in India, considerably affect the character and sub-aerial denudation of the surface rocks Compared to the soils of temperate zones the soil temperatures in India are 10°C to 20°C. higher, and therefore, all chemical reactions involved in the formation of soils proceed many times more intensively The high temperatures and humidity function so intensively that chemical decomposition follows almost at the heels of rock disintegration This feature is particularly conspicuous in the soil formation in the plains in India

Soils may also be divided into two groups (i) acid and (ii) alkaline on the basis of their chemical reaction. Alkaline soils are characterised by the presence of appreciable quantities of

calcium (lime) and sodium compounds Acid soils, on the other hand, contain various amounts of hydrogen which replaces calcium and sodium

Under climatic conditions where precipitation exceeds evaporation, the percolation of water downwards through the soil layers causes considerable leaching In this process the soil bases, particularly lime, are removed from the surface and their place taken by hydrogen, thus forming acid soils In such cases, the farmers add lime to the soil to remove its acidity. This practice of 'liming' is not very common in India

On Geological basis, the Indian soils fall into two broad divisions, the soils of the Sutlej-Ganga Plain and the soils of the Peninsular India.

SOILS OF THE SUTLEJ-GANGA PLAIN

The soils of the Sutlej-Ganga Plain are mostly alluvial. They are classified as sand, clay or loam, which have been derived from the debris brought down from the Himalayas or from the silt left, as in the case of Rajasthan, by the old sea which has now retreated These soils are the deepest, finest, and therefore, the most fertile in India They consist mostly of loam which is a mixture of clay and sand The proportion of clay in the loam increases in the newed alluvium, *e.g.*, nearer the deltas of the most important rivers The character of the soils of the Sutlej-Ganga Plain depends upon the part of the valley where they occur The soils are the coarsest in the upper section, medium in the middle section and finest in the lowest section of the valley Sand, being the coarsest, naturally predominates in the upper courses of the rivers, while clay, being the finest particle of the soil, marks the lower courses Locally sand or clay may occur in any part of the valleys provided there be an elevation where sand may be deposited, or a depression where clay may be deposited by the flood waters.

In the upper courses of the rivers sand predominates, being continually renewed by the floods from the Himalayas. Pebbles and large stones are also found mixed with it, specially in the river fans known as Bhabars The soil in this section is, therefore, not fertile In the middle courses of the rivers, deepest alluvium occurs in which clay predominates in depressions. The soil here is the most fertile In the lower courses of the rivers, finer alluvium in which clay predominates is the rule The depth of alluvium in this part is not much, but the fertility is great due to the frequent renewals of soils The fertility of these alluvial soils of the north is due more to the mixing up of the debris derived from new rocks of the Himalayas rather than to the prevalence of nitrogenous matter or humus The alluvial soils are composed of material drawn from different, rocks and

therefore, contain a great variety of salts. This varied nature of salts in these soils is the basis of their great fertility. The alluvial soils respond quickly to the use of manures. They are also easily tilled and are, therefore, the best agricultural soils of India.

Predominantly sandy ridges logically known as *bhur*, or alkaline stretches known as **reh** or **kalar** or **usar** are a feature of these soils. In clayey areas nodules of concentrated lime known as **kankar** also appear near the surface Such **kankar** deposits are especially marked in Bihar and the eastern parts of U.P

Besides the alluvial soils, there are some areas in the Punjab where wind-borne soils (loess) have covered the alluvial soils These loess soils are very fine-grained and highly porous

The alluvial soils of the Sutlej-Ganga Plain as of other parts of India also lack in the nitrogenous matter For example, the soils of the Punjab have been found to contain only from 0.025 p c to 0.100 p c[1] of nitrogenous matter as compared to about 20 p c. in the best steppe soils of Russia. The Indian soils, however, recoup their losses of the nitrogenous matter much more quickly than the Russian soils can do They are capable of fixing nitrogen very rapidly through leguminous crops.

The alluvial soils of the Sutlej-Ganga Plain are rich in potash, phosphoric acid, lime and organic matter but are deficient in nitrates and humus contents These soils are of marvellous fertility producing[2] under irrigation splendid crops of rice, sugarcane, tobacco and jute.

SOILS OF PENINSULAR INDIA

Most of the soils of the Peninsula are 'diluvial' as opposed to 'alluvial' soils of the north The diluvial soils remain in the area where they are formed and thus there is no mixing of different rock materials The fertility of the diluvial soils depends on the chemical constituents of the rocks from which they are derived The soils of the Peninsula have been classified under —

1. 'Regur' or the Black Cotton soil of India.
2. Red or yellow soils.
3. Laterite soils
4. Alluvial soils of the deltas.

1 The *Regur* or the *Black Cotton* soil has been derived from the old lava deposits and is among the most fertile soils of India. It is also known as the *Trap Soil*, as the lava deposits

1. See Pugh and Dutt, *Crop Production in India*, p 75
2. Mamoria, C. B, *Agricultural Problems of India*, 1953, p 46.

trapped or covered the original rocks It is so rich in plant food that it has been cultivated for thousands of years without the use of manure Its main area extends from Bombay in the west to Amarkantak in the east and from Guna in the north to Belgaum in the south In this area the black soil attains its greatest depth which is about twenty feet in its deepest parts The greatest fertility of the soil occurs in such parts Near the margins and on the slopes the soil is thin and the rocks buried under it generally appear on the surface Apart from this main area the Black Cotton soil is found also in scattered areas all over the Peninsula *e.g.*, in Bundelkhand, in Tinnevelly district of Madras, and near the Aravalli hills. The Regur of India is similar to the black soils of Arizona in the United States of America which, too, have been derived from the lava It is, however, different from the black soils of Ukraine in Russia or the Prairies in North America whose black colour is due to the presence of large quantities of vegetable matter in them These latter are, therefore, friable and easy to till, while the Indian soil is sticky and very difficult to work, particularly when it is wet

In some parts of the Peninsula, as in Gujarat and Madras, the origin of the black cotton soils is ascribed to old lagoons in which the rivers deposited the materials brought down from the interior of the peninsula covered with lavas

Krebs[1] holds that the Regur is essentially a mature soil which has been produced by relief and climate, rather than by a particular type of rock According to him this soil occurs where the annual rainfall is between 50 to 80 cms and the number of rainy days are from 30 to 50 The occurrence of this soil in the Western Deccan where the rainfall is about 100 centimetres and the number of rainy days more than 50, is considered by him to be an exception

These soils are highly retentive of moisture and extremely compact and tenacious They are rich in iron, lime and alumina. They are poor, however, in phosphorus and organic matter. The amount of potash in them is variable, but it is not much Thus it will be seen that these black soils are poor in those chemicals in which the other soils of India are rich These soils are specially suited for cotton, wheat and linseed, etc

The colour of these soils has been ascribed by some scientists to an organic compound of iron and aluminium The greatest agricultural drawback of these soils in India is that they crack into deep fissures when dry. They also cake and harden, making ploughing difficult

The fertility of the black soils is due to their retentivity of moisture; fineness and chemical matters, specially lime.

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1. Krebs, *Climate and Soil Formation in the South-India the Zeit, Erdkunda*, Berlin, 1936.

2. The *red* or *yellow soils* are characteristic of rocks in which large quantities of iron are present. Under uniformly high temperatures the iron disintegrates and is spread uniformly in the soil, giving it a red or yellow colour These soils are, therefore, common in the Tropics Their main stretch in India is south of the Tapti, though they occur in scattered areas even to the north of the Tapti and in Assam They are found associated generally with the Eastern Ghats. These soils are highly porous and are fertile only where they are deep and finely grained They are generally poor in nitrogen, phosphorus and humus. They are poor also in lime

3 The *Laterite soils* are highly infertile and are marked by barren areas where there is no vegetation They are red in colour and coarse Stony gravel marks their outer surface. Though red, the laterite soils are to be distinguished from the other red soils They are composed of a little clay and much gravel of red sandstone rocks. The laterite soils are, as a rule, very poor in phosphoric acid which is the most important plant food Laterite soils are formed under high rainfall which removes silica from them leaving behind hydrates of alumina in them Laterite is especially well developed on the summits of the plateaux and the hills of the Deccan, Madhya Pradesh, Rajmahal, the Eastern Ghats region of Orissa, South Bombay and Malabar, and parts of Assam.

4 The alluvial soils of the deltas are generally silt derived from the flood water of the rivers. Most of the rivers of the Deccan take their rise in the Black Soil area from which they carry large quantities away to the delta The general characteristics of these soils are similar to those of the Sutlej-Ganga Plain.

Other Soil Groups

In addition to above groups of soil, mention may be made of (1) Forest and Hill Soils, (2) Desert Soils, (3) Saline and Alkaline Soils, and (4) Peaty and Marshy soils

1. *Forest and Hill soils'* formation is governed mainly by the character of the deposition of the organic matter derived from the forest growth. The soils occur in the hill districts of Assam (they contain high proportion of organic matter and Nitrogen), in U.P. in the sub-Himalayan tract and in Coorg.

2 *Desert soils* are largely found in the arid regions of Rajasthan and South Punjab and are of brown colour. Some of these soils contain high percentage of soluble salts and varying percentage of calcium carbonate and are poor in organic matter. The limiting factor is mainly water, and reclamation is possible only if proper irrigation facilities are made available.

3 *Saline and Alkaline Soils* are extensively distributed throughout India in all the climatic zones Many parts of the dry tracts of the north, especially in Bihar, U P., Punjab and Rajasthan, give rise to saline and alkaline efflorescences, which are harmful for crops. It has been estimated that about 21 lakh acres in U P , 5 lakh acres in the Punjab and about 67 thousand acres in Bombay have been affected by *usar*.

4 *Peaty and Marshy Soils*. Peaty soils generally originate in humid regions as a result of accumulation of large quantities of organic matter They are black, heavy and highly acidic and are found in Kerala. Marshy soil are met within the Coastal tracts of Orissa, Sunderbans and some parts in Bengal, North Bihar and South-east Coast of Madras.

SOIL FERTILITY IN INDIA

Indian soils are classed among the fertile soils of the world. This does not mean that the yield of crops from them is necessarily very high· it only means that they are suitable for crop production. High yields of crop always go with intensive farming, implying efficient manuring at suitable intervals No soil, however fertile it may be, can show large yield without the addition of suitable manures

Maeriker classified soils into various classes on the basis of fertility as follows —

Content of Plant Food in every 10,000 *lbs. of the Surface Soil*

Class of Soil	Nitrogen	Phosphoric Acid	Potash
Poor Soil .	5 lbs	5 lbs	5 lbs.
Normal Soil	15—25 „	10—15 „	10—15 „
Good Soil .	24 – 40 „	15—25 „	15—25 „
Rich Soil ..	over 40 „	over 25 „	over 25 „

"Indian soils, like all tropical soils in general, are very deficient in organic matter and nitrogen The phosphate deficiency is comparatively less marked, while potash deficiency is rare"[1] The system of agriculture in India has been adapted

1 M S Randhawa, *op. cit.*, p 30

with this deficiency in view The pulses, like *arhar* and *urad*, and the oilseeds, like groundnut are used in our agriculture largely to supply nitrogen to the soil These crops manufacture nitrogen from air at their roots through certain bacteria and thus enrich it to some extent. The poverty of the Indian cultivator does not enable him to use chemical fertilizers to supply nitrogen to the soil Lack of fuel wood in sufficient quantities in the villages also diverts from the soil to the kitchen fire this very valuable animal manure.

It has been felt that there is an urgent need for promoting the use of green manures and nitrogenous fertilizers on a large scale in all parts of the country Application of these, especially in conjunction with phosphatic fertilizers has been found to increase crop yields very considerably The use of green leaves and wild leguminous plants serve very well the purpose of enriching the soil.

During 1961-62 the demand for nitrogenous fertilizers amounted to about 26.70 lakh tons in terms of ammonium sulphate while their availability, including internal production and imports, was estimated at 15.0 lakh tons As usual, in 1962-63 the demand for nitrogenous fertilizers increased further while increase in the supplies was only about 70 per cent.

In 1960-61 an area of 115 lakh acres was green manured and it was estimated to rise to 150 lakh acres in 1961-62

In 1961-62, about 2950 thousand tons urban compost were prepared in 2135 urban centres and about 2560 thousand tons distributed In 1962-63 the production was estimated at 3100 thousand tons Schemes for the utilization of sewage and sullage were in operation in 70 important towns and cities They utilized about 20 crore gallons of sewage and sullage water per day for irrigating about 25000 acres.

SOIL EROSION

Nothing is more serious among the agricultural problems of India than the lack of realisation of the loss that the country is suffering through soil erosion. Thousands of tons of good soil are being washed away every year to the sea without the slightest attempt being made to check it in some measure. This loss is greater in India than in most other countries, because of the nature of the Indian rainfall. The huge rainfall of the country which ultimately causes great floods in the big as well as the small rivers of India carries away large quantities of soil from one part to the other, and finally to the sea The extensive areas of the ravine lands in the neighbourhood of rivers are a sufficient proof of this The pity of it is that we ourselves lend a helping hand to the running water to carry away our soil.

By destroying the vegetation cover of the soil, either through overgrazing or through cutting down of the forests we leave the soil unprotected against excessive erosion Excessive deforestation, overstocking of grazing lands and unsuitable methods of agriculture have been the major causes of erosion

The problem of soil erosion is a complicated problem For soil erosion varies from place to place according to the character of the soil, according to the slopes of the ground, according to the vegetation cover, according to the use to which the soil is being put, and according to the nature and the amount of rainfall The solution of the problem lies, therefore, not in any one fixed method but in adopting several methods that will take into consideration all the above factors. The main object is to retard the speed of run-off. Planting of trees, regulating grazing, building of dams across the ravine lands, and contour-terracing[1] are some of the methods that have been followed in foreign countries to check soil erosion.

An outlay of about Rs 72 crores has been provided for the execution of various soil conservation programmes as against Rs 1.6 crores in the First Plan and Rs. 18 crores in the Second Plan.

Contour bunding and terracing were carried out over a area of 7 lakh acres of Agricultural land during the First Plan and 20 lakh acres during the Second Plan The Third Plan envisages the extension of these operations to 110 lakh acres number of demonstration projects for the popularisation of dry farming techniques were undertaken during the Second Plan. Work on such projects has been extended during the Third Plan so as to cover an area of about 2 2 crore acres In 1961-62 new dry farming projects were started in addition to the 40 already established during the Second Plan.

Afforestation and other soil conservation measures in the catchment areas of river valley projects were carried out over about 1.40 lakh acres during the Second Plan. An allocation of Rs 11 crores has been made in the Third Plan for extending this programme to another 10 lakh acres

Other soil conservation programmes during the Third Plan include reclamation of about 2 lakh acres of water-logged, saline and alkaline lands in the Punjab, U P, Mysore, Gujarat,

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1 Contour terracing means making a level terrace on elevated ground running in the direction of the contour and not across it Thus, the water in the terrace flows only slowly and does not cause excessive erosion.

Maharashtra, Rajasthan and Delhi and about 40,000 acres of ravine lands

Under the All India Soil and Land Use Survey Scheme an area of 20 03 lakh acres had been surveyed till September 1961 as against the target of 25 lakh acres for the year 1961-62.

QUESTIONS

1 In what respects do the soils of the Peninsular India differ from those of the Indo-Gangetic Basin?

2 What are the characteristics of the Regur Soils of India? How do they affect the agriculture of the region?

3. Give an account of the soils of the Indo-Gangetic Valley.

4 What is Soil Erosion? Suggest some methods for checking it in India.

Chapter 5

Agriculture

Agriculture is the most important industry of the people in India Leaving out China, there is no country in the world in which so many people depend on agriculture for their livelihood as in India About 70 per cent of our total population is engaged in this industry. Yet, in spite of it, the present-day agriculture in India cannot be said to be a scientific agriculture It ranks first in the world in the production of groundnuts and tea and enjoys a virtual monopoly in production of lac It is the second largest producer of rice, jute, raw sugar, rape seed, sesamum and castor seed

The two outstanding features of agricultural production in India are the wide variety of crops and the preponderance of food over non-food crops The following table shows the area under major crops in 1950-51; 1955-56, and during the four years ending 1960-61 :—

Area under Principal Crops (in 000 acres)

Crop	1950-51	1955-56	1957-58	1958 59	1959-60	1960-61
Rice	7,61,35	7,78,91	7,97,84	8,14,37	8,28,29	8,33,35
Jowar	3,84,77	4,29,03	4,27,73	4 25,84	4,21,58	4,21,08
Bajra	2,22,96	2,80,18	2,75,96	2,79,99	2,67,50	2,80,63
Maize ..	78,07	91,32	1,00,79	1,04,57	1,07,06	1,07,58
Ragi .	54,44	57,01	58,01	61,92	59,64	57,60
Small Millets	1,13,80	1,31,84	1,20,18	1,24,17	1,24,20	1,22,45
Wheat .	2,40,82	3,05,59	2,89,84	3,11,41	3,25,42	3,17,51
Barley .	76,93	84,47	75,84	82,43	83,45	79,16
Total cereals	19,33,14	21,58,35	21,46,28	22,04,70	22,17,14	22,19,36

Gram .	1,87,06	2,41,66	2,24,64	2,48,65	2,53,72	2,34,83
Tur .	53,89	56,50	58,24	59,31	58,88	58,30
Other Pulses	2,30,80	2,75,52	2,73,59	2,85,89	2,88,80	2,83,54
Total Food grains .	24,04,89	27,32,03	27,02,75	27,98,55	28,18,54	27,96,03
Potatoes ..	5,92	6,91	7,93	8,58	8,81	8,84
Sugarcane ..	42,17	45,64	51,22	48,03	52,20	57,34
Black pepper	1 97	2,20	2,31	2,30	2,34	2,35
Chillies ..	14 64	14,93	15 54	14 71	14,72	14 92
Ginger	40	40	42	36	41	44
Tobacco ..	8,83	10,13	8,88	8,97	9,14	9,68
Groundnut .	1,11,06	1,26,85	1,58,65	1,45,75	1,48,64	1,54,55
Castorseed ..	13,72	14,18	11,05	12,03	11,68	11,35
Sesamum .	54,45	56,67	51,74	55,00	54,23	48,58
Rape & Mustard	51,18	63,16	59,58	60,21	71,51	72,65
Linseed .	34,67	37,77	31,71	39,65	48,04	42,33
Cotton	1,45,36	1,99,81	1,98,04	1,99,26	1,88,04	1,89,71
Jute ..	14,11	17 39	17,41	18,11	16,85	15,29
Mesta .	.	5,71	7,66	8,25	7,04	6,94
Tea	7,77	7,80	7,93	7,95	N.A.	N A.
Coffee .	2,24	2,49	2,44	2,67	,,	,,
Rubber	1,44	1,74	2,19	2,85	3,03	,,
Coconut ..	15,36	16,01	16,32	16,89	16,92	,,

Most of the cultivated area lies in the plains of the Ganga and the Sutlej and the coastal plains. More than one-half the area of these plains is under the plough The remaining part of the cultivated area lies scattered in the plateau region where the Black-Cotton Soil region is the most important. An important feature of the plateau region is the large proportion of cultivable area left as fallow Andhra, Madras, Maharashtra and Gujarat, Rajasthan and Madhya Pradesh showed the largest area of fallowland More than half the fallowland of India lay in these States A certain part of the agricultural area in India is cropped more than once in the year.

Of the gross cultivated area in 1960-61 roughly about 279 6 million acres was occupied by food crops, leaving only about 15 per cent for commercial crops like jute, cotton or oilseeds The gross acreage under important groups of crops in recent years has been as follows: (In million acres).

	1948-49	49-50	'50'-51	'55'-56	'59'-60	'60'-61
Food grains .	233·0	245·3	240 5	273·2	281·8	279·6
Sugarcane ..	3·8	3 6	4 2	4·6	5·2	5 7
Oilseeds ..	23 6	24 9	26 5	29 9	33·4	32·3
Cotton	11 3	12·2	14 5	20 0	18·8	19·0
Jute .	0 8	1·2	1 4	1·7	1 7	1·5

The following table gives area and product of principal crops in India for various years. (In thousand Tons).

Crop	'50'-51	'55'-56	'57'-58	'58'-59	'59'-60	'60'-61
Rice (cleaned)	12,025	2,71,22	2,51,10	3,03,54	3,09,63	3,37,00
Jowar	54,08	66,19	84,97	87,14	80,04	90,85
Bajra ..	25,54	33,74	35,63	37,89	35,19	31,34

Crop	'50'-51	'55'-56	'57'-58	'58'-59	'59'-60	'60'-61
Maize ..	17,02	25,61	31,00	33,81	40,06	39,15
Ragi ..	14,07	18,17	17,01	18,77	19,04	16,40
Small Millets	17,22	20,37	17,03	20,72	20,29	19,49
Wheat .	63,60	86,22	78,71	97,72	1,00,89	1,06,48
Barley .	23,40	27,71	22,56	26,72	26,74	27,34
Total cereals	4,17,44	6,57,94	6,32 05	7,55,03	7,47,22	7,92,72
Pulses :	50—51	55—56	57—58	58—59	59—60	60—61
Gram ..	35,93	53,32	48,13	68,81	55,02	62,07
Tur ..	16,92	18,32	14,50	16,71	16,67	20,44
Other Pulses	29,93	37,07	31,41	43,20	43,65	42,16
Total Food-grains	5,00,22	6,57,94	6,32,05	7,55,03	7,47,22	7,92,72
Oilseeds :						
Ground Nuts	34,26	38,01	46,36	48,12	39,42	43,54
Castor Seed	1,01	1,23	88	1,12	1,06	98
Sesamum ..	4,38	4,60	3,53	5,11	3,59	2,88
Rape & Mustard Linseed.	7,50	8,46	9,18	10,25	10,47	13,80

Agriculture in India is characterised by certain features which are not met within the agriculture of the industrialised countries of the West There the requirements of factory workers dominate agricultural production. The features of Indian agriculture are :—

(1) Most of the land in India is devoted to the cultivation of foodgrains About four-fifths of the cultivated area here is under food crops.

(2) There is no crop which is grown for the specific purpose of providing fodder for cattle or other animals Cattle fodder in India is largely a by-product of the food crops

(3) The use of manures is very scanty and haphazard. Most of the animal refuse which gives the best all-round manure, is burnt as fuel, owing to the scarcity of forests in the important agricultural areas here.

(4) The yield per acre, therefore, is very small.

(5) The Indian bullocks on whom falls the whole of the agricultural work are weak and puny creatures who cannot pull big ploughs necessary for deep ploughing

(6) As contrasted with the temperate land agriculture, Indian fields generally produce more than one crop in the year.

(7) Severe losses occur in Indian agriculture owing to droughts, as the irrigation facilities are inadequate.

The following table shows the productivity of principal crops in selected countries:

Average Yield per Acre in Lbs in 1957

Country	Yield
1. PADDY	
Japan	3,750
China	2,387
Burma	1,420
U S. A	3,030
Thailand	1,565
India	1,209
Pakistan	1,244
Egypt	4 628

1. M. S. Randhawa, *op cit*, pp 343-344.

Country	Yield
2 Barley	
Denmark	3,148
Japan	2,157
France	1,713
United States	1,297
Iraq	812
Morocco	774
India	748
3 Wheat	
France	1,872
Canada	1,512
United States	1,201
Australia	975
Argentina	1,153
Egypt	2,091
India	640
Pakistan	656
4 Maize	
Italy	2,143
United States	2,462
Egypt	1,987
Argentina	1,541
France	2,447
Pakistan	948
India	732
China	1,169
5. Sugarcane	
India	29,095
Pakistan	27,000
Indonesia	68,695
China	35,438
Hawaii	177,515
Egypt	78,341
Cuba	36,644
U. S. A.	48,439

Agriculture in India has not only to provide food for such a large population, but has also to provide the means with which to provide other requirements of life.

Of the total area of India, roughly 55 per cent is cultivable. About 9 per cent of the total area, however, is left fallow every year and only about 46 per cent is, therefore, the total net area sown annually A little less than one-half of the total sown area in India lies in the Sutlej-Ganga Plain.

More than two-thirds of the area sown in India is occupied by the three crops, rice, millets (Jowar, Bajra, Gram and Ragi) and wheat. Among other important crops are the oil-seeds and cotton.

There are two well-defined crop seasons, (i) *Kharif* and (ii) *Rabi*. The major *Kharif* crops are rice, jowar, bajra, maize, cotton, sugarcane, sesamum and groundnut. The major *Rabi* crops are wheat, barley, gram, linseed, rape and mustard.

Following are important food crops:

A FOOD CROPS

1. Rice

India is the second largest producer of rice in the world, the first being China. The following table gives the production of Paddy in sown countries in 1951-52 and 1958 in lakh metric tons :—

	1951-52	1958
China	483	866
India	313	452
Pakistan	118	120
Japan	113	149
Indonesia	65	117
Thailand	72	71
Indo-China	11	
Burma	55	65

Rice is by far the most important crop in India, from the point of acreage and the number of people it supports Rice is a special crop of the monsoon lands where alone it finds almost ideal conditions for its growth Sufficiently high temperatures,

high rainfall, and *FERTILE ALLUVIAL PLAINS*, this combination is seldom met with in any other climatic region of the world Besides this happy combination, the monsoon lands are densely populated areas with abundant supply of cheap labour. For it must be realised that rice cultivation is not suited to mechanical cultivation It needs plenty of hand labour But water is the limiting factor in the cultivation of rice in India. Mountain-slopes have been terraced or marshes drained to make rice farms wherever water is enough for the needs of rice. Where rain-water is not enough for rice, but where rice must be cultivated for some reason or the other, irrigation has to be provided. In general, it can be said that rice needs plenty of heat, plenty of rain, plenty of labourers, and plenty of alluvium to give plenty of food for plenty of people There is no other food which is so plentiful in India as rice, but the people who eat it are also plentiful and hence a shortage of rice in the country

Rice in Bengal

Bengal is the largest producer of rice in India. Almost in every district rice accounts for more than 60% of the sown area. Most of this rice is obtained from the *AMAN* crop which is sown in June and harvested about November It will be seen from the following table that during this period copious rain falls regularly in Bengal :—

Rainfall and Temperature in Bengal

Months	April	May	June	July	August	September
Rain (Centimetres)	8·4	19·3	36·8	37·8	35·5	27·1
Temperature (°C)	28·6	28·9	28·9	28 3	28·3	28 3

Bengal provides another requirement of rice cultivation in its uniformly high temperatures. But a high temperature is not so essential as high rainfall. For rice is cultivated on the slopes of the Himalayas even on heights of 8,000 feet (2438 metres) or so above sea-level where temperatures are not high.

Except China, about which reliable statistics are wanting, India produces and perhaps consumes also the largest amount of rice in the world Most of the Indian supplies come from Andhra, Madras, Bihar, Orissa, M P., and Bengal During 1955-56 these States produced about 50% of the total Indian crop Generally speaking, about one-third of the total crop is contributed by the two States, Bengal and Madras, Bihar and

Orissa contribute about another one-third The following table shows States' share in rice production .—

Area and Production of Rice, 1957-58

States		Acres ('000)	Production ('000 Tons)	Yield per Acre in Lbs
Andhra	..	6,974	3,468	1,114
Bihar	..	12,215	2,198	403
Assam	..	4,207	1,586	844
Madhya Pradesh	.	9,664	2,093	485
Madras	.	5,605	3,134	1,252
Orissa	..	9,476	1,755	415
U P.	..	9,637	2,284	531
Bengal	..	10,771	4,185	870
Kerala	..	1,912	..	1,024
Bombay	..	4,124		746
Total India	.	72,027	24,821	704

A comparison of the rainfall map with rice map shows the dependence of rice cultivation in India on rainfall. As one pro-

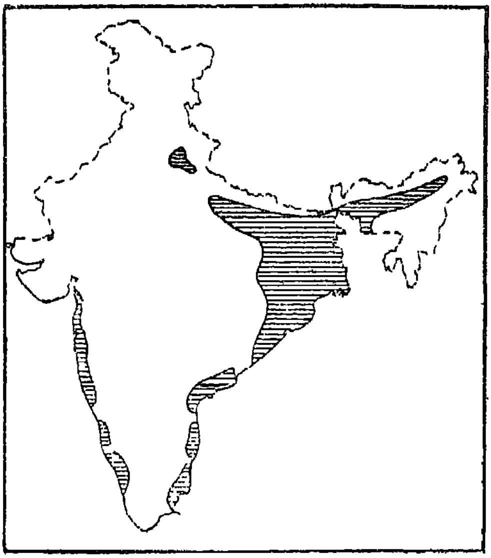


Fig 14 Distribution of Paddy cultivation.

ceeds further into the interior of the country where rainfall decreases, there is a fall in the cultivation of rice. A large proportion of the rice grown outside Bengal and Assam is irrigated. This is specially so where either the rainfall is precarious or scanty. Rice crop cannot bear long intervals of drought Except in U P and the Punjab, there are two to three crops of rice every year, autumn, winter and spring crops

Rice is considered generally as a winter crop in India, as over the whole of the country it is harvested mainly from November to January The sowing lasts from April to August for most of the varieties grown in India But in the main rice producing areas of Bengal, Assam, Bihar, Orissa, and Madras there are autumn and summer crops of rice as well The rice season in Madras varies greatly The first crop is sown between May and December and gathered from September to April. The second crop is sown between October and March and harvested between January and June

The three main crops of Bengal and the neighbouring areas are given in the following table —

Rice Crops of Bengal

	Crop	When sown	When transplanted	When harvested
1	Aus	April-May	Sown (Broadcast)	August-September
2.	Aman	June	July-August	November-January
3	Boro	October	December	March

When rice is cultivated on high lands or on dry lands which are not completely submerged during the rains, it is sown broadcast in the field itself But when it is cultivated in lowlands which are filled with water during the rainy season, it is first sown in nurseries from where the plants are transplanted into the fields when they are about a foot high.

In those lowlands where the water is too deep for trans plantation of rice plants, a special crop of rice is sown broadcast in February or March before the rainy season starts. This crop is harvested only after the water has subsided in the field after rains

(1) AUS or *autumn rice* crop This is sown in April or May on comparatively high land and harvested in August or September AUS paddy cannot be grown on land on which more than two feet of water accumulates during the rainy season The land on which this paddy is grown is generally light and easily workable

(2) AMAN or *winter rice* crop is sown from May to June and harvested from November to January. It faces complete submergence and the uprooting action of rushing water It increases in height with the rise in water level

Aman rice is the most important in Bengal. More than three-fourths of the rice acreage and output is accounted for by it. The following table shows the share of each crop .—

Crop	Acreage%	Output%
Aman .. .	86	87
Aus	13	10
Boro .	1	3

(3) BORO or *summer rice* crop It is sown in depressions and swamps from October onwards when the rain water has subsided and is reaped in March It grows in dry season and has to face droughts during the latter period of its growth when the water in the depressions is drying up The yield per acre of this rice is the highest.

The rice crop in Bengal, and in other areas where irrigation is not much practised, is damaged to some extent by the vagaries of rainfall The rice crop of Bengal is also sometimes damaged by untimely floods in the Ganga due to late and heavy rainfall in U.P. These floods fill the depression along the river with water which cannot be used for sowing the rice crop, as the water does not dry up in time for sowing

Rice cultivation in Bengal is done almost without any manuring of the fields It is only recently that green manuring is being advocated Fortunately, however, large parts of Bengal are subjected to river floods resulting in considerable deposits of silt which help the land to regain fertility To save the cultivator from loss, the Agriculture Department has developed by research early-maturing varieties, as also high-yielding varieties Among the improved varieties, may be mentioned the "Dhoiral" of Bengal which yields up to 1200 kilograms per acre (2,560 lbs.).

OTHER AREAS

The distribution map of rice below shows that there are two areas in India which grow practically no rice These are the Black Cotton Soil area and the desert and semi-desert of Thar and Rajasthan These areas do not have enough water for rice cultivation.

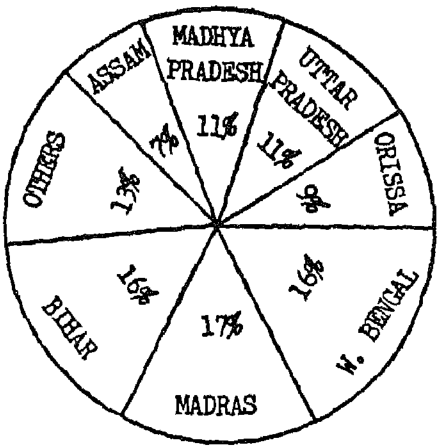
In the Punjab rice is grown in the canal-irrigated areas during summer only.

Rice is also important all along the Himalayas in the Terai region, as well as in the mountain river valleys Kashmir is an important producer. In these parts there are two crops of rice raised, owing to early maturing varieties.

Other areas where rice crop covers over 80% of the sown area are Cuttack, Puri and Sambalpur in Orissa; Kamrup and Goalpara in Assam; and Tanjore and Kanara in Madras, West Godavari in Andhra In Kerala also it is an important crop.

In U P the eastern districts and the submontane districts are the chief producer of rice Rice is, however, also cultivated to some extent in the canal-irrigated areas. There is only one crop of rice raised here. The crop is, however, pre-

RICE



STATE DISTRIBUTION

Fig 15. Rice Percentage

carious in eastern districts, whenever the rainfall is short or irregular. There are not enough facilities for irrigation of rice in these districts Rice requires plenty of water for irrigation which cannot be easily raised from the wells common in these districts of U P

INCREASING SUPPLY

In spite of the large acreage under rice in India the yield per acre is very low This is due to the absence of manuring in India The average yield per acre in India is only 1204 lb (545 17

kgr) as compared with Japan's 3,750 lbs. The highest yield of rice in India is in Bengal. India does not produce rice enough for her own requirements This deficit will increase as the population increases unless greater outturn of rice is possible We have already seen that water sets a limit to further extension of rice cultivation in India The only method, therefore, to increase the output is to increase the yield The yield at present can be raised only by greater application of manure

The Government is popularising in this country the Japanese method to increase the yield of rice per acre The chief features of this method are (i) the use of less and better seed, (ii) sowing the seed in a raised nursery-bed; (iii) transplanting the seedlings in rows so as to make weeding and fertilizing easy, and (iv) increasing use of natural and chemical fertilizers like compost, green manures and ammonium sulphate

The Japanese method of rice growing has been successfully adopted in most States in India The area under Japanese method of cultivation increased from 4 lakh acres in 1952-53 to 13 lakh acres in 1953-54 and 21 lakhs in 1955-56 This was further raised to 56 lakh acres in 1958-59 In 1958-59 the area under Japanese method stood at 56 lakh acres The yield of rice per acre under Japanese method is about 20 maunds, whereas under local method only about 11 maunds The production of paddy is as much as 700 kilograms per acre.

TRADE IN RICE

The trade in foodgrains is not free now. Movement of rice is on Government account now.

The Indian Government has to import rice from any country with which it can bargain In 1951 about 7 4 lakh tons were imported, and 3 9 lakh tons in 1958 The imports came from Burma, Thailand and Egypt

The import figures for the last some years are as follows:

Year	Import (lakh tons)
1951	7 49
1956	3 25
1957	7 36
1958	3 91
1959	2 90
1960	6 88
1961	3 78
1962	3.84

Rice was imported mainly from Burma, Thailand and Egypt

The large population of the rice-growing parts of India does not leave any surplus of the crop for export purposes Most of the trade in rice is inland trade. The largest inland movement of rice is from Madhya Pradesh, a thinly populated area The largest inward movement is into Kerala, Madras, Maharashtra and Bengal, where the rice-consuming population is considerable, but where the local produce is not enough

Rice husking mills first clean the paddy and remove the husk before the rice is brought to the market In the rice-growing areas there are many rice mills, the largest number being in Bengal. In some of these mills, the husk is used as fuel, in others oil-burning machinery is common The rice straw is tough when dry, owing to the hot and moist conditions under which rice grows It cannot, therefore, be used as fodder. It is used for thatching of roofs or for making mats With industrial development of the country it can be used for various purposes like cardboard making and several other packing uses etc. These uses can bring to the cultivator plenty of money.

(ii) Wheat

Wheat is the most important commercial grain in India, for people prefer it as a staple food It is important in areas in which rice is not important, because the climate and soil requirements of the two grains are different. Wheat requires a fertile loam or any other fertile soil, provided it is not too wet It grows best in a cool, moist climate and ripens best in a warm, dry climate. The ideal wheat climate is that wherein the annual rainfall is between 20 to 30" (50 to 75 cms) the winter temperature is between 50-60°F and the summer temperature is between 70-80°F and where there exists good facilities for irrigation The largest acreage under wheat is found, therefore, in the drier and higher parts of the Sutlej-Ganga plains During 1957-58 out of the 29.6 million acres under wheat in the whole of India more than 17 million acres or about 60 p c were in the Indo-Gangetic Valley west of Varanasi and only 1 million acres, mostly in Bihar, in the lower Gangetic Valley east of Varanasi There is no factor so injurious to wheat as the excessive humidity which marks the eastern section of the Gangetic Valley, both because of higher rainfall and its heavy soil Madhya Pradesh, U P, Punjab, Rajasthan, Bihar, Maharashtra and Gujarat States are the chief producers of wheat in India. All these parts are in the interior of the peninsula away from the wet coastal regions.

Thus it may be said generally that wheat cultivation in India increases from the south to the north; that is to say, on leaving the humid atmosphere and the inundated soils of the

south and the east. Wheat is practically absent from the red and yellow soils The other area without wheat cultivation is the Thar desert

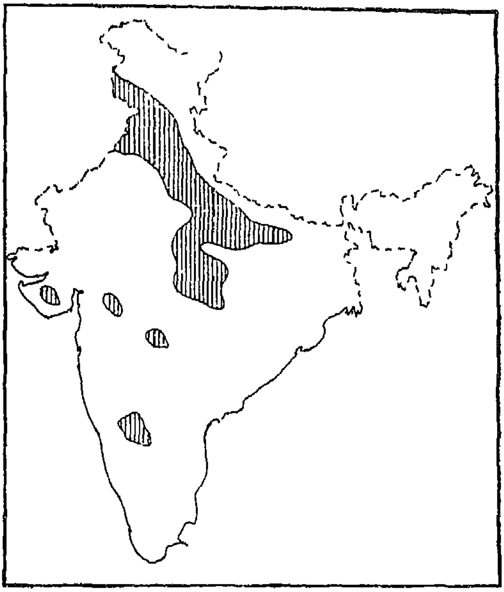


Fig No 16 Distribution of Wheat Cultivation

The following table shows the record of acreage and production of wheat in India for various years:

Year		(in 000 acres)	(in 000 tons)
1950-51		2,40,82	63,60
1955-56	..	3,05,59	86,22
1957-58		2,89 84	78,71
1958-59		3,11,41	97,72
1959-60	.	3,25,42	1,00,89
1960-61	..	3,17,51	1 06 48
1961-62	.	3 32,10	1,16,20

WHEAT IN PUNJAB

Before partition the Punjab, with its fertile, alluvial loam, its moderate rainfall, its cool winters and abundant irrigation

facilities easily occupied the largest share. On the basis of the ten-year average (1930-31 to 1939-40) two million acres or 29 p c. of the total acreage under wheat in India was in the Punjab In 1958-59 in Punjab wheat acreage was 53 50 lakhs and production 23 lakh tons. Most of the wheat area in the Punjab was found in the northern Punjab Thus, the five districts, Lyallpur, Multan, Attock, Ferozepur and Montgomery accounted for about one-third of the total wheat area of this state They are all in Pakistan now It is in the northern Punjab that abundant irrigation facilities are found This naturally accounted for the importance of wheat there Not only in area, but in wheat output also the Punjab ranked first in India. About 3 million tons, or 30 p.c. of the total output came from the Punjab. While in area and in total output Punjab stood first in wheat cultivation, its yield per acre was comparatively low. If the average yield per acre is compared, Punjab stood sixth in the provinces, important for wheat in India then. Even the best yield in Punjab was lower than the best yield in some other provinces The highest recorded in Punjab was 1250 lbs per acre in Jullundur, which may be compared with 1374 lbs in Nawabshah in Sind, and 1300 lbs in Bulandshahr in U P After partition, the Punjab became second only to U P in wheat production

WHEAT IN U P.

In 1958-59, U P had 9 5 million acres or about 33% of the total wheat area in India The total output was 3 million tons or about 30% of the Indian output. In fact U P. and the Punjab account for more than about one-half of the area and about two-thirds of the output of wheat in India Most of the wheat area in U P. lies in the Doab between the Ganga and the Ghogra rivers More than one-half of the wheat area is in this region Next in importance comes the Doab between the Ganga and the Jamuna. The least important districts for wheat in U P are those lying at the junction between the Peninsular regions and the Ganga plain The wheat cultivation is also important in the districts east of the Ghogra, owing to the fertile soil and the irrigation facilities from wells. In fact the largest acreage under wheat in U P is in the districts of Gorakhpur This is, however, due to the fact that this district has the largest cultivated area in U P The proportion of the area under wheat to the total cultivated area in this district is only about one-seventh This may be compared with the one-third in Meerut and one-fourth in Bulandshahr Other important districts are Dehra Dun, Saharanpur, Etawah, Moradabad, Budaun, Shahjahanpur and Nainital

The average yield per acre is the highest in Punjab when compared with other States. Higher yields in Punjab are charac-

teristic only of the irrigated areas in the Ganga-Jamuna Doab and in the districts east of Ghogra It is the unirrigated areas that lower the average yield in U P.

Other Areas

A study of the geographical distribution of wheat in India reveals that it is grown mostly in the alluvial soils of the Sutlej-Ganga basin and the Black Cotton Soil of the Peninsula, provided the rainfall is less than 40 inches.

The relative importance of wheat is not the same for all states in India In some it is more important than in others. In Bihar it is only 5 p c of the total net area cultivated. In the two most important wheat states of India (Punjab and U. P.) the percentage is 29 and 22 respectively It must be realised that wheat is a money crop and has, therefore, to compete against other money crops like sugarcane and cotton The best land is, therefore, divided among the money crops This division, however, depends upon rainfall fluctuations When rainfall conditions are unfavourable the poorer crops like barley or gram occupy the land that is usually allotted to wheat.

PECULIARITIES OF WHEAT IN INDIA

A special feature of the wheat crop of India is that unlike that of the cool temperate countries of the world where alone the largest supplies of wheat come from, in India it is a winter crop For it is only then that suitable temperatures are avail-

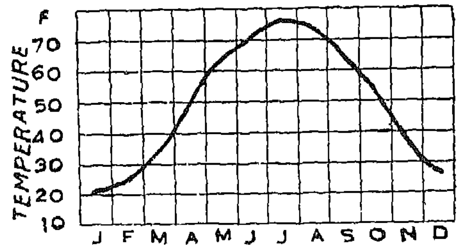


Fig 17 Temperature required for wheat.

able here Wheat is sown in India from October to December and is harvested from March to June in different parts. As winter is a dry period over the area where wheat is grown here irrigation plays the most important part in its cultivation in India In some years when the monsoon rainfall has been in defect, even sowing of wheat is done with the help of irrigation In Europe and in America, wheat is grown in summer when enough rain falls Irrigation is therefore, not an important fea-

ture of wheat cultivation in those regions. It is only in Australia, South Africa, and the western part of the United States of America, which are practically deserts, that irrigation is resorted to for this crop. After about a fortnight from the end of monsoon this crop. After about a fortnight from the end of monsoon rains in Northern India and when the nights have become sufficiently cool to cause the formation of dew in the field, *i.e.* about the end of October, wheat is sown in the fields, which have been prepared beforehand. Wheat is sown only in the loamy soil of the older alluvium The field in which wheat is intended to be sown usually remains fallow during summer when a little manure is also given. Unlike most of the summer crops, which are sown broadcast, wheat is carefully sown in the drills made by the plough This is a clear proof of the esteem in which the Indian cultivator holds it for its commercial importance The winter rains and the facilities of irrigation in the areas in which wheat is important are an advantage to wheat in India, as they provide moisture to the plant during its early growth which, accompanied by the cool temperature of December, helps tillering, and a number of stalks shoot the same seed By the end of February when the grain has formed, temperatures begin to rise and help in the ripening of the crop

There are certain climatic drawbacks under which Indian wheat is cultivated. These drawbacks arise particularly about the time of harvest The change from winter to summer is almost sudden in India The rise of temperature is not gradual, as in Russia or Canada or the other wheat-producing countries, and therefore, the crop matures not gradually but quickly This sudden ripening of the crop leads to the inferiority of the wheat grain in India The rise of temperature is usually accompanied by the setting in of very dry winds which quickly dry up the sap in the grain. It is thus not a fully developed well-rounded grain as in other countries, but a shrivelled up and thin grain. This wind often blows with considerable speed and tends to spoil the crop by felling the plant to the ground, as the indigenous Indian plant has a weak straw. Local storms leading to hail and rain are also common in Northern India during March and April and cause difficulties in the gathering in of the crop

In India most crops are harvested by gathering in the whole plant and not only the grain, as in America, because in India the straw has considerable importance for fodder Among villages in India, while there is trade in grain there is *PRACTICALLY* **NO** trade in fodder which has, therefore, to be carefully conserved. This method of crop gathering in India causes considerable amount of impurities in Indian wheat for which it was disreputed in the world market

See the climatic conditions under which wheat is grown in the Punjab and in Canada Note from the shape of the

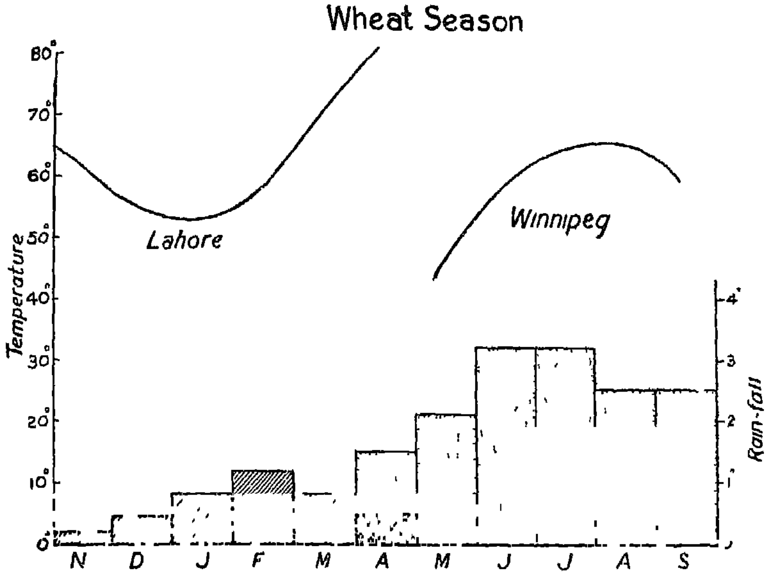


Fig 18 Showing Temperature

curves the sudden and the gradual rise of temperature in the two areas In India the crop ripens in suddenly increasing temperature, while in Canada it ripens in gradually falling temperature. The amount of rainfall during the wheat season in India clearly indicates the necessity of irrigation In Canada, on the other hand, rainfall is enough for the crop

It will be noticed that in India while the *growing period* of wheat is characterised by *favourable* climatic conditions, the harvesting period is marked by *unfavourable* conditions

The yield per acre of wheat in India is very low, owing to the poverty of the Indian cultivator who cannot afford much manuring Even though farming here is 'intensive', Indian yield ranks with the lower yields of the newer countries of America or Australia where the farming methods are 'extensive' and cannot, therefore, produce high yields per acre The yields per acre in the 'intensive' farming countries of western Europe are about three times as much as in India. The largest yield per acre in India is in the western districts of U P. and the lowest in Chhota Nagpur It is to be noted that the yield per acre is low in all the important producers of wheat in the world. Russia, U S A, Canada, India and Argentina, all re-

cord low yields But the difference between U S.A or Canada and India is between extensive and intensive agriculture U.S A and Canada generally have extensive agriculture in which less manure is used, and therefore, low yield per acre results. In India lack of manure is due to poverty of the cultivator.

INCREASED SUPPLIES

Shortage of wheat supplies in recent times in India has drawn attention to the possibilities of increasing supplies of wheat in the country It will be noticed that geographical considerations limit the cultivation of wheat to certain areas of India only. But wheat is a commercial crop in India that is grown essentially for its money value It has, therefore, to compete with other commercial crops, like cotton or sugarcane During the last few years, owing to the great rise in the prices of these latter crops, a certain amount of land suitable for wheat cultivation has been diverted to their cultivation The wheat supplies of India have, therefore, not kept pace with the increasing population of the country This has naturally resulted in a shortage. Under normal conditions, however, the working of the laws of Economics would adjust the shortage by making it worth-while for the farmers in India to devote more land to wheat But India needs not only more wheat, but also more cotton and more sugar now The only method of increasing wheat supplies, therefore, lies

(i) in extending irrigation facilities to bring more land under wheat cultivation,

(ii) in introducing scientific agriculture by improving seed, manuring, cultivation, etc.

Only one-third of the wheat crop in India is irrigated The other two-thirds of it has still to do without it If irrigation could be provided for this portion of the crop, increase in supply is bound to occur

Similarly, the use of manures, better seed and other improvements in wheat cultivation are likely to increase the yield of wheat per acre, and therefore, the total supplies.

TRADE IN WHEAT

India normally stood fourth among the world producers of wheat But the tremendous increase in wheat cultivation in U.S A., Canada and Argentina during the last World War has placed India in a lower position. The largest producers of wheat in the world are Russia, U.S A , Canada, Argentina and India Indian produce is about one-third of that of Russia and about one-half of that of U.S A The commercial significance of the Indian crop formerly lay in the fact that it reached the European market when the crop of other countries were still growing in the field. The importance of this fact, however,

has considerably dwindled now, because of the large wheat stocks in the world market in normal times. The demand for Indian wheat in Europe was mostly for mixing with other varieties of wheat to produce a big loaf Most of the exports went to Great Britain, Belgium, Germany and Italy. Within recent years, owing to the shortage of food in India all exports of wheat from India have ceased On the other hand, India has to depend on imports of wheat from outside Only recently India contracted with the U.S A for the import of wheat and wheat flour

The imports of wheat and wheat flour into India for the last some years were as follows. —

Year	Import (lakh tons)
1951	30 15
1956	10 95
1957	28 52
1958	26 73
1959	34 97
1960	43 17
1961	30 43
1962	31·99

The largest inland movement of wheat and flour is from the states where it is produced most, *viz.* the Punjab, U P. and Madhya Pradesh The largest inward movement is into Calcutta where a large wheat-consuming population has gathered from the north Bombay and Rajasthan, where the wheat produced is less than the local demand, are other areas of large demand The movement is, however, now on government account only and is all over the country according to requirement.

(iii) Barley and Gram

Barley and gram are two other winter grain crops which rank along with wheat as staple foodgrains of Northern India. Together they occupy about the same acreage as wheat in India. The largest production of these grains is in those parts of the Sutlej-Ganga Plain where wheat cannot be grown as a winter crop. Thus, dry, sandy or moist clayey areas, as well as those areas where irrigation facilities are lacking are devoted to these grains Barley and gram mixed together provide the poor man's food in those parts of Northern India where rice is not abundant. About two-thirds of barley and about one-half of gram supply of the whole of India comes from Uttar Pradesh Two chief zones of barley production are (i) north-western districts of Bihar—Saran, Champaran and Muzaffarpur, and (ii) north-eastern districts of U P—in the districts of Varanasi, Jaunpur,

Azamgarh, Ghazipur, Allahabad, Ballia, Pratapgarh and Garhwal. Some barley is also grown in Punjab The yield per acre of these grains particularly of barley is higher than that of wheat They also do not require so much care and attention as wheat, but they are cheaper and do not fetch as much money as wheat It is, therefore, only under compulsion from nature that the Indian cultivator grows them His first preference in northern India is always wheat There is very little in these grains A small amount of barley is used for brewing beer; while some amount of gram is used as horse or animal feed.

Following is the acreage of production of barley and gram for various years

BARLEY

Year	(in 000 acres)	(in 000 tons)
1957-58	75,84	22,56
1958-59	82,43	26,72
1959-60	83,45	26,74
1960-61	79,16	27,34
1961-62	82,50	30,70

GRAM

Year	(in 000 acres)	(in 000 tons)
1957-58	2,73,59	48,13
1958-59	2,85,89	68,81
1959-60	2,88,80	55,02
1960-61	2,83,54	62,07
1961-62	2,40,80	58,50

(iv) Millets

Millets include a number of inferior grains in which *Jowar*, *Bajra* and *Ragi* predominate. These grains cover a larger acreage than any other grain in India, except rice Millets are grown in all those areas where the soil is rather infertile owing to its rocky or sandy character The largest arceage under them occurs in the Peninsular India with Maharashtra, Gujerat and Mysore states leading. The least acreage is in Bengal *Jowar* prefers wetter and more clayey soil, while *Bajra* grows well in drier and sandier soil The millets are the chief summer grain crop in all the areas where rice is grown Their importance lies not only

in the fact that they are a staple food for a very large section of the people of the peninsula throughout the year and in north-

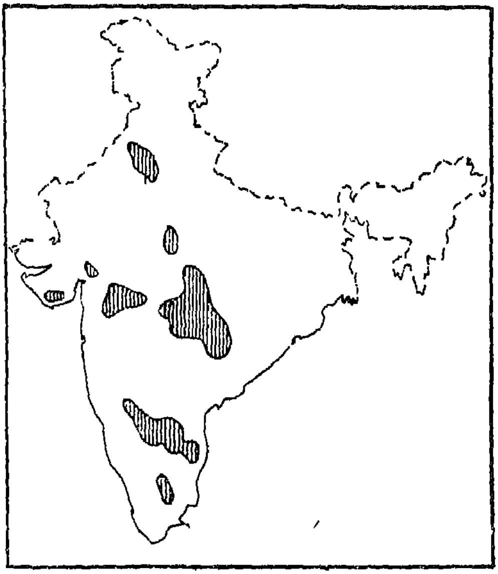


Fig. 19 Cultivation of Jowar in India.

ern India during winter, but also in the fact that they provide a substantial part of the fodder supply of India The fodder value of the Jowar plant is so great that in some parts of U.P and the Punjab the crop is raised even by irrigation solely for that purpose. Dr. Voelker in his report on Agriculture in India speaks very highly of the nutritive value of Jowar as a fodder There is practically no trade in millets

The total India acreage under Jowar (in 1961-62) was 430 7 lakh acres and the production 76 6 lakh tons For Bajra the respective figures were 270 3 lakh acres and production 35 lakh tons Jowar is more important in Maharashtra and Gujarat states as a *Rabi* crop than as a *kharif* crop. These are the only States in India where *Jowar* is grown as a *rabi* crop, as well as a *kharif* crop *Jowar* is a staple crop where black and mixed black soils predominate, provided the rainfall is moderate and well distributed Important producers of *Jowar* are Maharashtra, Gujarat, U P, Madras, M.P, Central Rajasthan, and Punjab Where the rainfall is excessive it gives place to rice as can be seen in the region of the Malabar coast. On sandy loams and shallow soils its place is taken by *Bajra.* In U P and the Punjab *Jowar* is also grown as a fodder crop. It is then known as *Chari* and is given irrigation when necessary

The following table shows acreage and production for Millets,* during various years, in the Indian Union

Year	(in 000 acres)	(in 000 tons)
1950-51	6,62,17	93,69
1955-56	7,66,22	1,18,10
1957-58	7,61,79	1,37,61
1958-59	7,67,75	1,43,80
1959-60	7,48,72	1,34,27
1960-61	7,59,31	1 38'59

*-i e. Jowar, Bajra and Ragi

(v) Maize

Maize also, like the millets, is considered as an inferior grain in India It prefers fertile soil, especially loam and is, therefore, grown mostly in U.P., Rajasthan and the Punjab More than four-fifths of the crop is found in the Sutlej-Ganga Plain. It is grown with the first summer rains and is reaped almost as soon as the rains stop Its cultivation is adversely affected if the rains come late, and the crop is damaged, if there are very long intervals between the rainy periods The cultivation of maize as well as the millets in India is characterised by 'interculture', that is, several things are sown mixed Among the seeds sown thus, are several vegetables, like pumpkins and cucumbers, various kinds of pulses like *Urd*, *Mung* and *Arhar* and some oilseeds like sesame. All these, except the *arhar* are collected before the main crop *Arhar*, on the other hand, takes full winter to mature and is harvested separately with the rabi crops.

This 'interculture' has an important and scientific place in the agricultural practice of India Some of the crops like the *arhar* have deep tap roots on which form the bacteria which enrich the soil Interculture has thus its agricultural value The vegetable crops mature quickly and provide food to the poor agriculturist at a time when his stock of food is at the lowest Interculture has thus its economic value

There is only local trade in maize Its stalks, too, are tough when dry and have no value for fodder. They are generally burnt or used for thatching

Climate in India does not favour the cultivation of maize to any large extent Very high temperatures during the growing period are the main obstacle It will be seen that the region of the greatest production of maize is the United States of America, which produces the bulk of the world's supply of

maize, has a mean summer temperature of 70° to 80° F In India, on the other hand, we notice that the average is more than 85° F during the period maize is grown here This unfavourable climate is mainly responsible for the low yield per acre in India in comparison to the United States.

The following table gives the acreage and production of maize in India for a number of years

Year	(in 000 acres)	(in 000 tons)
1950-51	78,07	17 02
1955-56	91,32	25,61
1957-58	1,00,79	31,00
1958-59	1,04,57	33,81
1959-60	1,07,06	43,06
1960-61	1,07,58	39,15

The crop is raised mainly for consumption in areas of production and hence exports are inconsiderable In recent years industrial firms have developed the production of starch and glucose from maize

B NON-FOOD CROPS

1 Sugarcane

The cultivation of sugarcane has made enormous progress in India within very recent years as a result of the growth of Indian cane-sugar industry under the State protection Thus, the history of sugar beet in Europe has been repeated in India in the progress of sugarcane The growth of cane cultivation in India is shown by the rise in area under cane from 4 2 million acres in 1950-51 to more than 5 17 million acres in 1959-60 and 5 93 million acres in 1961-62 The greatest expansion has been in Bihar and U P where the best conditions for cane cultivation are found

At one time India had the largest acreage under sugarcane in the whole world Indian acreage was about three times that of Cuba and about seven times that of Java, the two islands which have dominated the world production of sugarcane in the past India was also the largest producer of cane sugar in the whole world, producing about four times that of Java, Hawaii or Brazil, about three times that of Philippines and about one and a third times that of Cuba. Even now India is

the third largest producer after Brazil as is evident from the following figures :—

World Production of Cane sugar in 1958 (in lakh metric tons)

Cuba	..	59·6	Australia	..	14·3
Brazil	..	35·9	Union of S Africa		10 3
India	.	24 5	Mexico		13 6

This great production in India was due not to high yields but to the immense area under sugarcane The production of sugar in India, however, surpasses all countries producing beet sugar.

The production of sugar in India previously used to surpass all countries producing beet sugar, but recently U S S R has started producing beet sugar which is even greater than the output of cane sugar in Cuba However, the production of cane-sugar in India is greater than the production of second largest producer of beet-sugar *viz.* U.S.A The following figures for beet-sugar may be compared with the previous figures for cane sugar :—

World production of cane sugar in 1958 (*in lakh metric tons*)

U. S S. R.	.	62·6	Poland	12·1
U. S. A	.	19 9	Italy	11 0
W. Germany	.	19 1	E. Germany	9 3

Even though sugarcane is grown all over India in favourable localities to some extent or the other, because of its great money yield, its greatest concentration occurs in the submontane districts of the Middle Ganga Valley, where U.P has 59 per cent of the total Indian crop, the Punjab (11%) and Bihar (17%) together accounts for four-fifths of the sugarcane area of India.

This concentration is due to .

(i) the fertile alluvium which is renewed every year by the numerous mountain streams flowing into the area;
(ii) the high water level enabling easy irrigation;
(iii) the flat plains providing ease of cultivation,
(iv) absence of frost;
(v) high rainfall;
(vi) high temperatures, and
(vii) facilities of irrigation from the many wells (which cost very little to build) and canals.

In U P. the most important districts producing sugarcane are Saharanpur, Shahjahanpur, Fyzabad, Azamgarh, Ballia, Varanasi, Jaunpur, Bulandshahr, Pilibhit and Gorakhpur U.P raises 49% of the Indian crop.

In Bihar the important sugarcane-growing districts are Champaran, Saran, Darbhanga and Muzaffarpur. Bihar raises 6% of the total Indian production

In Punjab the cultivation is concentrated in Amritsar, Jullundur and Rohtak. It raises 10% of the Indian production.

There are, however, small areas of cane cultivation spread locally all over the country They have not been shown in the map, because the areas are too small. The existence of such areas clearly proves the importance of sugarcane as a money crop to the Indian cultivator.

The yield per acre of sugarcane is higher in the Peninsular region than in the north. The yield of sugarcane in Maharashtra is 53 25 tons per acre which is even better than Java's yield. The average percentage recovery of sugar from cane is 11.49% in Java whereas it is 11 80% in Maharashtra. The average Indian figure for the recovery of sugar is 9.84% The reasons for better yields in southern India are more suitable climatic conditions and greater use of fertilizers. The following table shows the yield per acre in some important sugarcane-growing countries of the world :—

Hawaii ..	80	tons per acre	Philippines	27	tons per acre
Java	50	,,	Mauritius	19	,,
Peru .	41	,,	Cuba	17	,,
Egypt	30	,,	U. S. A	20-30	,,
Puerto Rico	30	,,	India	15	,,
Formosa	28	,,	..		

In 1958-59 out of the total Indian acreage under sugarcane (of 48 lakh acres) 27 4 lakh acres was in Uttar Pradesh alone, and out of the total sugar production of 704 lakh tons, U P 's contribution was 307 6 lakh tons

The Indian cane is of a thin variety and is not so thick as the cane in Java or other tropical islands where the continued supply of moisture and hot temperatures produce plenty of juice in the cane. In India, the long break in the rains does not favour the growth of thick, juicy canes under average conditions. The cane which has practically supplanted the old indigenous varieties in India is the Coimbatore cane, bearing different numbers according to the seedlings obtained by crossing with different varieties as well as with other plants like Jowar.

Coimbatore has been selected as the centre for researches in sugarcane, because its climate is ideally suited for cane. One important effect of the introduction of the Coimbatore cane has been that 'ratooning' has become popular in India. Ratoon crop is the second or any successive crop of cane obtained from the roots of the cane left over in the field from the first crop.

Ratooning avoids the need of fresh sowings of cane every year. In India ratooning is generally uneconomical after two years, as the crop becomes infested with cane diseases like 'red rot'. The sucrose content of the Punjab cane is, however, lower than that of the canes of U P or Bihar. This is believed to be due to the soil differences. The amount of exchangeable calcium in the Punjab soil is lower[1]

Most of the cane produced in India is used locally for crushing in the sugar mills erected all over the sugarcane area in the country One of the main factors in the rapid increase of sugar cultivation in India has been the demand for cane from these mills. The land lying near these mills, wherever practicable, has all been converted into caneland, the cane replacing all other crops An important example of this replacement is noticed in the Terai region of the Himalayas where the land, formerly given to rice is now devoted to cane The following table shows the acreage and production:—

The following table gives the area and production of sugarcane for various years

Year	Area (in 000 acres)	Production (in 000 tons)
1950-51	42,17	5,61,50
1955-56	45,64	5,95,87
1957-58	51,22	7,00,31
1958-59	48,03	7,04,56
1959-60	52,20	7,52,01
1960-61	57,34	8,50,45

2. Oilseeds

The importance of oilseeds in India is more for their oil being used for food than for industrial purposes There is a large variety of oilseeds grown all over India both as a summer and a winter crop, but the greatest importance attaches to groundnuts, cotton-seed, rape-seed and mustard The yield of the first two of these is generally more than twice the yield of all the others put together The importance of oilseeds for export trade is considerable also The oilseeds are divided into two broad classes, edible and non-edible The latter includes linseed and castor U P is the largest producer of oilseeds in the country

1 *Agriculture and Animal Husbandry in India*, Government of India Publication.

Production and Acreage of Oilseeds in India

(Area in thousand acres. Production in thousand tons)

		1950-51	55-56	57-58	58-59	59-60	60-61
Groundnut ..	Area	1,11,06	1,26,85	1,58,65	1,45,75	1,48,64	1,54,55
	Production	34,26	38,01	46,36	48,12	39,42	43,54
Castorseed .	Area	13,72	14,18	11,05	12,03	11,68	11,35
	Production	1,01	1,23	88	1,12	1,06	98
Sesamum ..	Area	54,45	56,67	51,74	55,00	54,23	48,58
	Production	4,38	4,60	3,53	5,11	3,59	2,88
Rape mustard	Area	51,18	63,16	59,58	60,21	71,51	72,65
	Production	7,50	8,46	9,18	10,25	10,47	13,80
Linseed ..	Area	34,67	37,77	31,71	39,65	48,04	42,33
	Production	3,61	4,13	2,55	4,47	4,31	4,10

The table on the last page shows the figures for oilseeds.

The total area under all the oilseeds in India in 1961-62 was about 342 2 lakh acres which was more than the area under wheat in this country. About half of this area is in the Deccan plateau. The production amounted to 68.3 lakh tons The largest area under oilseeds is in U P

Groundnuts are by far the most important among the oilseeds in India from the point of view of area and production. It is an important money crop for the farmer. About one-third of the total acreage under oilseeds is occupied by this one crop. India is now the largest producer and exporter of groundnuts in the whole world, as well as the largest consumer More than one-third of the world's total acreage under groundnuts is found in India. The importance of this crop in Indian agriculture is only recent At the beginning of this century there were less than 3 lakh acres under it in India This importance developed mainly on account of its export value. Today, however, the home market is more important than the export market, for India now consumes more than three-fifths of the crop The growing use of *Vanaspati* which is manufactured from the groundnut oil is largely responsible for this The principal area under this crop is in Madras, Bombay, Andhra and Mysore Practically the whole crop is grown in the Peninsular India. U P. is the only important producer outside the Peninsula. The groundnut, apart from yielding the oil which is used for making vegetable ghee, increases the fertility of the soil, because of its bacteria-forming roots In Mysore Ragi sown after groundnut was produced on an experiment farm 88% more than Ragi sown after Ragi.

The cultivation of groundnuts requires a light soil, perfectly rich in organic matter The red and yellow and the black cotton soils of the Peninsula suit it well. Much rainfall is not required; a rainfall of 20 to 30 inches (50 to 75 centimetres) is quite enough, if it comes during the growing season In Madras and Bombay part of the crop is raised with irrigation Groundnuts cannot stand in low temperature; they need a temperature of 70° F to 80° F. (20°C to 25° centigrade). Dry weather is required at the time of ripening.

In the beginning of the present century, groundnut cultivation in India occupied only a minor position, but it has now assumed great importance and plays a vital role in the country's economy Prior to World War I, the area under groundnuts in India was hardly 10 per cent of the total area under oilseeds; during 1955-56 it had risen to 65 per cent, but in 1961-62 it was about 46%.

Nearly 78 per cent of the groundnut area is concentrated in Madras, Maharashtra, Gujarat, Andhra and Mysore, the promiment varieties grown being the Coromandal and peanuts. *Bold-nuts* grown in Bombay with a lower oil content, are specially valued for eating as such.

The crop in India was primarily developed as an export commodity and the world prices had a decisive influence on the development of its cultivation in this country. Events, however, have changed the entire pattern of India's groundnuts economy. Exports which occupied a dominant position in pre-World War II years have now given place to domestic consumption. Crushing within the country amounts to nearly 82 per cent of the total production as against 49 per cent before World War II.

Owing to their high fat and protein content, groundnuts form a rich food, but the consumption of kernels is still small; the per capita consumption being only 1.78 lbs

The groundnut crushing industry has made rapid strides Crushing in power mills and village 'ghanis' accounts for the largest share of the groundnuts. There has been nearly cent per cent increase in the production of groundnut oil as well as cake.

The following table shows the acreage and output in India.

Year	(in 000 acres)	(in 000 tons)
1950-51	1,11,06	34,26
1955-56	1,26,85	38,01
1957-58	1,58,65	46,36
1958-59	1,45,75	48,12
1959-60	1,48,68	39,42
1960-61	1,54,55	43,54
1961-62	1,58,50	46,80

Cotton seed also is mostly produced in the Peninsula *Coconut* and *Castor* are also almost a monopoly of the Peninsula.

Rape and *Mustard seeds* are very widely grown in Sutlej-Ganga Valley. They are not important in the Deccan, as they prefer a fertile, alluvial soil with comparatively dry winters. Out of the total area of 62 lakh acres under this class about 35

lakh acres are in the northern parts of the country. In the Punjab, the crop is known as Toria. In U.P. this crop is grown alone only over a small area which is only about 3.6 lakh acres. A large amount of this crop is, however, grown in this state mixed with other winter crops U.P. occupies the highest place in the cultivation of Rape and Mustard.

Sesamun (*Til* or *Jinjali*) is also very widely grown in India. It is, however, more important in the Deccan than in the Sutlej-Ganga Valley. Madras, Bombay, Andhra and Madhya Pradesh are more important.

Linseed is another important money crop for the Indian farmer It has acquired a great importance within recent years in Indian agriculture, owing to its enhanced importance for export trade to Great Britain It now occupies over 3 million acres, most of it lying in U.P. It is, therefore, insignificant when compared with Argentina, in South America

Castor is also important only in the Deccan. Andhra, Madras, Mysore, Maharashtra and Gujarat account for practically the whole of the crop Bihar and U.P. are the only nominal producers outside the Peninsula

The exports of oilseeds have, on the whole, now decreased Groundnut is an exception, the marked increase in its export being due to an increase in area. The exports of oilcakes and vegetable oils have also increased, but the increase in the quantities of oilseeds crushed for local consumption is still more striking. From the increased quantities of oil manufactured in India, various minor industries have developed, *e.g.* soap-making, hair-oil-making, paint and varnish-making and vegetable ghee-making Gouripore in Bengal is now famous all over India for the supply of boiled linseed oil for the paint and varnish industry.

The export of oilseeds is not profitable to India. It is against the real interests of the country. The main arguments against this export are that by exporting the raw oilseeds to foreign countries —

(1) India loses the oilcake which is a valuable manure for the soil and a nutritious cattle fodder.

(2) India has to buy back from these countries at a high price the vegetable oil that it needs for her industrial purposes like the making of paints and varnishes and soap, etc.

(3) India thus pays the higher wages of the foreign labour employed in oil-crushing industry in foreign countries, while depriving her own people of the work and the wages they could get in crushing mills in India.

(4) The development of our industries like soap-making, etc. is retarded for want of cheap vegetable oils.

The policy of the Central Government is to allow the export of vegetable oils rather than the oilseeds for two reasons —first, to promote the development of oilseeds crushing industry in India, and secondly to have oilcake within the country. Export of oilseeds had, therefore, remained banned for some years.

3. Tea

Tea is now the important money crop in India. The cultivation of tea was started in India by the Government, as an experiment, in 1834 This experiment was undertaken as a result of a minute recorded by Lord William Bentinck, the then Governor-General of India It was urged in that minute that great "advantages would result to India, in commercial point of view, from the success of the scheme, and that it would also place England in an independent position in respect to China" A committee of thirteen members was appointed to start the scheme. Two of the members of the committee were Indians and the rest Europeans.

The Committee obtained a quantity of seed and a few seedlings from China which succeeded well in the soil of Assam A few tea-makers and artisans were also introduced from China in 1937. Some consignments of the tea thus produced in Assam were then sent to London for sale. These consignments proved of excellent quality and fetched a very high price The prices commanded by this tea were so good that the experimental tea cultivation in India attracted the attention of British capitalists A company, later known as the 'Assam Company' was, therefore, formed for tea cultivation in Upper Assam The Indian Government transferred to this company most of its gardens and nurseries

The Committee appointed by the Government also discovered that the tea plant grew wild over a tract of Assam, extending from Sadia to Yunan, the frontier Province of China.

The tea plantation in India was, therefore, started with three types of plant: the Chinese type, the indigenous type, and the hybrid type (a mixture of the first two)

The China type is very hardy and yields under circumstances that would be fatal to the more delicate indigenous or the hybrid type But the China type produces a hard leaf which costs more in manufacturing and is of less commercial value than the tea produced from the indigenous or the hybrid types The hybrid type has, therefore, become popular in India.

India is the largest producer of tea in the world. About 47% of the total world production of tea came from India in 1961 and about 30% from Ceylon The crop is, however, highly concentrated in a few hilly districts of India. 76% of the total area under tea plantations lies in Assam (in the Brahmaputra and Surma Valleys) and in the two adjoining districts (Darjeeling and Jalpaiguri) of Bengal The elevated region over the Malabar Coast, in Southern India (including the Travancore-Cochin, Malabar, Nilgiris and Coimbatore) contains 19 p c. of the total The Punjab, U.P and Bihar account for the rest There are about 7,273 registered gardens with a total area of nearly 8,04,000 acres under tea Of these 5,95,030 acres are in Assam and West Bengal, while Madras, Mysore and Kerala account for nearly 1,77,960 acres and the rest are in Bihar, U.P, Tripura, Punjab and Himachal Pradesh The daily average number of persons actually employed in 1956 was 10,62,036. The tea industry as a whole gives employment to a labour force of almost 1 2 million. The capital invested in tea industry amounts to Rs 113 06 crores of which about 36% is Indian and the rest non-Indian There are about 7273 registered tea estates in India comprising about 3,04,000 acres These estates employ about 9 lakh people in the tea industry and the capital invested amounts to Rs. 113 06 crores of which about 36% is Indian and the rest non-Indian

Area and production of tea in the world for 1958 is as follows:—

		Area ('000 hectares)	Production ('000 Metric tons)
India	..	321	302
Ceylon	..	231	180
China	..	..	114
Indonesia	..	141	67
Japan	..	45	72
Pakistan	..	31	20
		——	——
			759

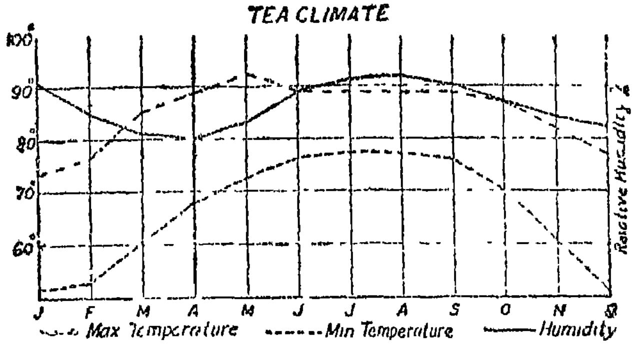


Fig. 20 Meteorological Observations at Jalpaiguri, Bengal,

The ideal climate for the cultivation of tea is the one where the daily variation of temperature is from 75° to 85° F If the atmosphere is very moist, this variation may be a little greater A rainfall of about sixty inches annually, if it is well distributed throughout the year, is enough Nothing is more injurious to tea crop than long dry periods.

The previous graph shows at Jalpaiguri, an important producer of tea in India, the temperature during the producing period from June to September varies between 78° and 89° F (26°C and 32°C) The relative humidity of the air, that is to say, the proportion of moisture in relation to the temperature, during this period is very high; about 90%. From March to May, the temperatures are very high and the range between the highest and the lowest temperature great, as is seen from the distance separating the lines of minimum and maximum temperatures in the graph. During this period, however, the relative humidity is very low, when compared to other months. But even this low relative humidity is never below 80% This fact is an important climatic factor favouring tea cultivation in this district.

A soft and well-drained soil is the best for this crop Light sandy and deep loams are much preferred. Apart from the production of leaves on the tea-bush, the flavour of tea depends largely on the chemical constituents of the soil. Relatively large quantities of phosphorus and potash in the soil account for the special flavours of the tea produced in Darjeeling The soils in which tea is grown in the Himalayas vary considerably, but the best is a light, rich soil containing a good deal of humus mixed with sand.

The tea plants are raised from seeds and not from cuttings The plants, reserved for seed production, are not used for

gathering the leaves, but are allowed to grow to a height of 20 or 30 feet (6 metres to 9 metres) The seeds are sown in nurseries and the seedlings, when about six months old, are then planted in fields which have been specially prepared beforehand

The sowing of seeds starts in October or November and continues up to March The seedlings are transplanted when the rains begin During dry periods after transplantation irrigation has to be provided to help the plants to grow up The plant is ready for plucking in three years. The season for gathering leaves commences about the beginning of April and continues until October There are generally three gatherings from each plant every season The first is some time from April to June, the second from July to August and the third from September to October The number of gatherings, however, depends entirely on the nature of the season If the season is good, that is to say, if rain falls in winter and in spring, as many as five gatherings may be obtained

Pruning of the plant is an essential part of tea cultivation It is done annually during the period when the plant growth has stopped. In India the period of pruning is generally from December to March The aim of pruning is to have new shoots bearing soft leaves in plenty It also keeps the tea bush low enough to facilitate the plucking of leaves from the ground

In order to help the plant to grow plenty of leaves, considerable attention is paid by the tea-planter to maintain it in good health Frequent tilling of the soil to eradicate weeds, and the use of several kinds of manures is generally practised. The most common manures in India are the oilcakes. Recently, green manuring has also been practised. In Ceylon, large quantities of chemical manures, like sulphate of potash are used.

In India, tea is grown in three different climates :—

(i) in the cooler climate of the hills—Darjeeling, Kumaon, the Nilgiris and the Kangra Valley;

(ii) in the warmer climate—Lower Assam;

(iii) Midway between the above two—Upper Assam. The districts where the indigenous tea plant was found growing wild

The third is about the best climate for tea in India.

There is an intimate connection between the climate, the yield and the quality of tea in these areas. In the hilly areas mentioned under (i) above, the yield is low, but the quality is

good; in the areas under (ii) above, the yield is the heaviest, but the quality is worse The area under (iii) above must be regarded as a whole, midway both in yield and quality between (i) and (ii)

The largest production of tea in India comes from the following areas .—

1. *The Brahmputra Valley in Assam.* The *most* intensive cultivation of the tea here is found on the red alluvium which forms small plateaux in the districts of Tezpur and Bishnath.

2 *The Surma Valley.* This valley comprises mainly of Cachar district There are many *tilas* or low hillocks all over the district These hillocks are surrounded by low-lying flat land, locally known as *beel,* which was formerly a swamp. These swamps have now been drained, and in many cases black soil highly charged with organic matter has been uncovered On these soils tea flourishes exceedingly well In addition to these flat lands, tea has been planted also on plateau land similar to that in the Brahmaputra Valley

3 *The Duars.* There is a strip about ten miles broad lying at the foot of the Himalayas, south of Sikkim and Bhutan. The most characteristic feature of this strip is a bank of hard but porous red soil on which tea has been extensively planted

The greater yields of manufactured tea per acre plucked are recorded in the Brahmaputra Valley of Assam The average yields here are more than 700 lbs per acre The lowest yield is in Garhwal, about 60 lbs. to the acre

Most of the tea produced in India is 'Black Tea' Very small quantities of 'Green Tea' are produced here. The Kangra Valley is responsible for producing more than two-thirds of the Green Tea in India

The difference in the black and the green teas is, of course, one of method of the preparation of the leaf The Chinese green tea is coloured artificially by ferrocynide or iron and Prussian blue which gives them their fine bluish colour. No artificial colouring of tea is, however, done in India

The manufacture of tea or the preparation of the leaf for the market is comparatively a simple process It involves the drying of the leaf partly in the sun and partly on fire The proximity of forests to tea plantation is an advantage, because it gives charcoal for fire and wood for packing boxes In nature, all the tea leaves are green.

Until recently, the Indian tea industry depended for its prosperity almost entirely on the foreign market, especially British The exports of Indian tea are the largest in the world

and are taken mostly by Great Britain which accounts for about 87 p.c. of our exports A considerable proportion is re-exported from there to the European countries in which Russia is the most important. Russia is, however, developing her own tea plantations in Georgia. Turkey is also growing tea in the neighbourhood of Ria on the Black Sea Canada, U.S A., Iran, Ceylon and Burma also take our exports Among all the producers of tea India has the largest home market.

Thus, not only is the tea production in India confined to a small area but its trade is also limited almost to one market —Great Britain.

Practically all the exports of Indian tea go from the port of Calcutta to the following destinations percentage of which is given below for the year 1961-62 :—

U K. .	59·9%	Sudan	2 6%
U S. S R .	7·1%	.	..
Egypt	7 0%	Iran	2·1%
U. S A	5·2%	Turkey	1 9%
Canada	3 0%	Others	8·4%
Irish Rep	2 8%	=Rs. 1224 million	

The following table shows tea exports by sea from the Indian Union to other countries·

(in million lbs)

Country		1956	1958
United Kingdom	..	365·40	330·92
U S. A.	..	28·36	25 49
Canada	..	22 59	19·04
Iran		8·31	12 02
Egypt		23 11	25·52
U S S R		13 65	25 28
Eire	..	16 74	15 85
Sudan		6 70	13 96
Australia		9 40	7 29
Turkey	..	5 82	8 21

The application of restriction to the tea industry since 1933 has resulted in many gardens producing the permissible crop from a smaller acreage than they are at present cultivating This has resulted in throwing out of commission the poorer producing area and obtaining the crop from the areas producing the greater crop The poor areas so thrown out of commission are being replanted with new and better plants so that in a few years' time, when these plants become mature, such areas will have a considerably greater potential producing capacity This scheme of restriction in India is under the control of the India Tea Licensing Committee, which works under the International Tea Restriction Board located in London The function of this body is not only to fix export quotas for various countries and tea estates there, but also to create new markets for tea. For this purpose the Tea Board has been brought into existence. It arranges for free supply of tea to expand its market and carries on an advertising campaign in favour of tea drinking The activities of this Board are financed by a tax levied on all exports of tea from India Owing to the activity of this Board in India the home consumption of tea has been rising

As may be expected, the working of the restriction scheme has resulted in bringing into prominence certain economic considerations, such as the desirability of producing a large crop from a small area so as to reduce costs and also the production of the best quality owing to the limitation of the total crop. An experimental research station for tea exists at Toklai in Assem.

Recently, growing of shade trees amongst the tea plants has been started, because the tea under shade has a better cropping value than the tea away from shade Several species of leguminous trees have been planted for this purpose

The tea plantations of India covered about 7¾ lakh acres in 1957 During this year India produced 664 million lbs of tea This was an all-time record Of this produce about 110 million lbs was from the south The position of Assam is outstanding In Assam the most important districts are Darrang, Sibsagar, Lakhimpur and in Chachar, Sadia frontier also grows large amount. In southern India, roughly about half of the production comes from Kerala. The Punjab, U P. and Bihar produce only minor amounts In the Punjab it is grown in Kangra Valley; in U P in Garhwal and Almora districts and in Bihar in Purnea, Ranchi and Hazaribag

Production of tea in India

Year	Area (in acres)	Production (in lbs.)
1950—51	7,77,000	6,07,00,000
1955—56	7,80,000	6,28,00,000
1957—58	7,93,000	6,78,00,000
1958—59	7,95,000	6 98,00,000
1960	..	7,07,000,000
1961	.	7,79,000,000
1962	..	75,80,00,000

Acreage and production of tea in India during 1958

State	Acreage ('000)	Production (Mln Lbs)	Yield per Acre
Assam	393 4	378 88	946
West Bengal .	201.6	169 74	N A.
Bihar .	1 7	15	N A
Tripura } ..	12 4 }	7 03	N. A.
U P }	5.9 }		
Punjab	9 6	2 26	243
Madras and Coorg	76 4	68 08	771
Mysore ..	4 46	3 66	614
Kerala	97 08	79 92	N A.
Total	803 78	715 96	

During 1950-51 exports of tea were valued at Rs 8,042 lakhs forming 13 51% of the total value of exports from India During 1957, they amounted to Rs 12,346 lakhs, forming 19 35% of the total Indian exports.

In 1962-63 there was an increase of Rs 6 93 crores in the foreign exchange earned by exports of tea while in 1961-62 the value of tea exported from India was Rs 129 crores and in 1960-61 it was Rs. 122 crores Thus tea is an important foreign exchange earner being a traditional export item of India and occupying the second position.

Against the total quantities of tea produced in India, 201 million lbs of tea were available for internal consumption during 1951-52, and 176 6 and 180 million lbs during 1953-54 and 1954-55 In 1962 total production of tea was 758 million lbs out of which 298 million lbs were available for internal consumption and 460 million lbs. were exported to foreign countries.

The tea producing target for 1960-61 was 700 million lbs. out of which 470 to 500 million lbs. were to be exported.

The production and export target were reached in 1958 only Third Five-Year Plan target of tea production for 1965-66 has been kept at 900 million lbs annually, whereas export target has been fixed at 550 million lbs.

The Indian production of tea is the largest in the world, forming about 50%. This is about twice that of Ceylon, three times that of Indonesia and about four times that of Japan

The effect of the two Great Wars has been to stimulate considerably the production of tea in India for British and other markets Great Britain has, however, entered into an agreement with the Indian tea industry, whereby the prices charged from Britain will not be excessively high.

Amount of foreign exchange earned for various years (in million Rs.)

1950—51	..	804
1955—56	..	1087
1959—60	..	1291
1960—61	..	1236
1961—62	..	1224

Recently a grave threat has been posed by India's competitors in tea exports such as East Africa, Ceylon and Japan etc In the decade ending 1961 India's share in the world export of tea has dropped from 44 9% to 37.6% while the share of her competitors has increased correspondingly. Out of all Ceylon is the stiffest competitor Her production and exports of tea have been steadily rising for the last five years whereas in India they have been fluctuating as may be clear from the following figures·

Ceylon (to the nearest million lbs)

	1958	1959	1960	1961	1962
Production of tea	413	413	434	455	470
Exports " "	411	383	410	426	451

8

Production and export figures of India have been given elsewhere in the preceding pages. The position will be clearer on comparing the figures of India and Ceylon.

So this is high time that suitable steps should be taken to boost up the production of Indian tea.

Drought is the main malady. A suggestion has been given to instal deep tube-wells to supply water during the dry periods particularly from November to April. But it is a very costly scheme.

Among the schemes under implementation for development and encouragement of the tea industry are the promotional activities in India and abroad of the Tea Board, loans granted to poorer gardens for repair and improvisation and renovation of plant and machinery, supply of machinery on hire-purchase basis, grant of transport subsidy in certain cases, supply of fertilizers to the gardens and research in the tea industry.

4. Coffee

Although the coffee industry in India falls far short of the tea industry in the country, it is interesting to note that in Southern India it covers a larger cultivated area than either tea or rubber.

In 1960-61 'Coffee plantations' covered an area of over 2.95 lakh acres and production was 67,800 tonnes. Coffee production in 1961-62 was 45,700 tonnes and in 1962-63 it has been estimated to be 54,800 tonnes.

Coffee growing was established on a firm footing in Southern India in the last century, between 1830 and 1840, first in Mysore and then in Wynaad, Nilgiri and Shevaroi Hills. Later in 1854, the first coffee plantation in Coorg was opened from which a great expansion has taken place.

The coffee industry of India is confined to Southern India comprising Madras, Mysore and Kerala. Of the total area under coffee Mysore accounts for more than half, and Madras and Kerala 22 p c each. The highest average yield per acre of plucked area is in Cochin and the lowest in Mysore

The following table shows the acreage and production of coffee in India :—

Progress in coffee industry may well be judged by the following table:

Year	Area (in acres)	Production (in tonnes)
1947—48	218840	16000
1950—51	228630	18890
1955—56	254450	35000
1957—58	268470	44490
1958—59	272300	46600
1959—60	294900	49740
1960—61	295000	67800
1961—62	—	45700
1962—63	—	54800

In Mysore the plantations are mostly confined to the south and west especially in the districts of Kadur, Shimoga, Hassan and Mysore. In Madras the coffee plantations are found mostly in the south-west from North Arcot to Tennevelly. Nilgiri is the important area In Andhra it is grown in Vishakhapattam.

The principal markets for Indian coffee are the United Kingdom, France, Germany, Holland, Australia, Iraq and Belgium Indian production of coffee is insignificant in comparison with the world production of coffee.

The Indian coffee crop gives, on an average, an yield of about 17,000 tons The consumption of coffee in India has stepped up from 8,000 tons in 1940 to 35,000 tons in 1960-61 but recently it has again somewhat fallen down to 25,900 in 1961-62 Export of coffee has also increased from 8000 metric tons in 1955-56 to 32,270 m tons in 1960-61, although coming down to 19830 m. tons in 1961-62 The coffee industry provides employments to over 2 lakh persons India produces some of the best coffee in the world, and yet her exports are negligible, especially because of the competition from Costa Rica, British East Africa and Colombia The consumption of coffee in India is very low. About 96 per cent of the coffee available for home consumption is consumed in Madras, Mysore and Kerala. The rest of the country consumes only 4 per cent.

The consumption of coffee in India has increased from 8000 metric tons in 1940 to 35,000 metric tons in 1960-61 and out of crop about 20,000 metric tons of coffee was exported to foreign countries.

The coffee industry provides employment for over 2 lakh persons.

The Third Five-Year Plan targets of production and exports have been kept at 80.000 metric tons and 45,000 metric tons respectively.

5. Tobacco

Tobacco requires a good soil and heavy manuring. The best kind is a well-drained, friable, sandy loam, not too rich in organic matter, but rich in mineral salts like potash, phosphoric acid and iron Light soils which allow a full development of the roots of tobacco are the best for it But heavy soils are used in India for growing **Hookah** tobacco. It is most susceptible to frost. It is, therefore, grown largely in the frost-free provinces, **viz.** Bombay, Madras, Bihar and Bengal.

The Indian variety of tobacco (*NICOTIANA RUSTICA*) is a more rapidly growing species other than the variety generally grown in the temperate regions of the world (*Nicotiana Tobacum.*) In the field this tobacco grows most rapidly with a mean temperature of about 80°F. It also requires a liberal, well-distributed rainfall or its equivalent in irrigation water. For the water requirements of the plant are high. Tobacco plant is also very sensitive to defective drainage or waterlogging of the soil. It needs well-drained soil.

In the cultivation of tobacco it is the quality of leaf rather than quantity that is aimed at High yields of leaf always imply a rank vegetative growth For good cigarette tobacco, therefore, relatively low yields are essential to the production of leaf of the highest quality

The importance of Indian tobacco is considerable as a money crop. It is used in large quantities in the making of Bidis which are growing in popularity among the masses In world production of tobacco India ranks high, contributing about one-fifth of the total.

Year	Area of Cultivation (in acres)	Production (in tons)
1950—51	8,83,000	2,57,000
1955—56	10,13,000	2,98,000
1957—58	8,88,000	2,36,000
1958—59	8,97,000	2,61,000
1959—60	9,14,000	2,81,000
1960—61	9,68,000	2,94,000
1961—62	10,20,000	3,40,000

The Production of some countries in 1958:

Country	Production ('000 Metric tons)
U. S. A.	787 5
India	256.0
Brazil	143.9
Canada	138 0
China	104 0

Tobacco is grown mostly wherever the soil is a rich sandy loam with water only a few feet below the surface Shallow wells are dug all over the tobacco fields, and during certain stages of the growth of the crop hand irrigation is done daily. The irrigation is followed not only to supply moisture to the roots but also to wash the dust from the leaves Wherever the red clay soil appears, tobacco cultivation is not found.

More than 2|3 of the acreage and output of tobacco in India are found in the states of Madras, Andhra and Bombay.

In Madras, tobacco is grown in all districts, though on the Nilgiris and the West Coast the area is small. The seed beds are usually located near shallow pools in which the monsoon rains stand.

The increase in the production of flue-cured and other types of cigarette tobacco in India has led to a decrease in the

imports of readymade cigarettes into India. The number of flue-curing barns in operation, on the principles evolved at Pusa, now exceeds 2,000.

About 80% of the total output of tobacco in India is consumed internally. In 1960-61 consumption of tobacco in India was expected to be 648.32 million lbs. which is supposed to rise to 799 52 million lbs in 1965-66. Despite the increasing consumption of tobacco India exports 45 to 50 thousand tons of good quality tobacco and earns the foreign exchange to the value of Rs 10 to 12 crores per year.

The countries were·—

U K	65.3%	Belgium	1 8%
U. S A	7.3%	Singapore	1 8%
Ceylon	4 0%	Poland	1.8%
Aden	3 4%	Others	14 6%

Export of Tobacco

		(in crores of rupees)	
		1960—61	1961—62
1	Tobacco Leaf .	14 67	14 03
2.	Cured Tobacco .	1 13	0 91

C. FIBROUS CROPS

1. Cotton

Until the partition, cotton was the most important commercial crop in India Apart from providing materials for our cotton mills, it brought to the cultivator and others engaged in cotton trade crores of rupees from export Raw cotton had the largest share, about one-fifth in our exports It was pre-eminently a money crop for the Indian cultivator

After the partition, however, India is no longer self-sufficient in raw cotton, and it has lost its importance in the export trade. Mainly because our own textile mills now need more raw cotton owing to their rapid progress during the war.

Owing to rapid agricultural advance in China and the U S.S R, now India has been thrown down in the fourth place among cotton producing countries of the world, as may be evident from the following table·—

World Production of Cotton (ginned) in 1958
(in '000 metric tons)

U S.A.	2506
Chaina (mainland)	2100
U S.S.R.	1495
India	837
Mexico	510
United Arab Republic (Egypt)	446

The area under cotton in India in 1960-61 was 19 million acres and the production about 53,94,000 bales.[1]

The comparative importance of cotton is greater in Bombay and Madhya Pradesh where before the war it occupied 19 to 20 p c. of the total net cultivated area, than in other provinces, say for example, U P, where the percentage was only about 1. Even in the Punjab, cotton occupied only 9 p c of the total net cultivated area of the province. Apart from the competition offered to cotton by other commercial crops, soil well suited to cotton is not easily found outside Black Cotton Soil region. This fact is largely responsible for the varying importance of cotton in different States of India

A reference to the cotton map, and its comparison with the soil map will show that the cultivation of cotton in India is closely related to the 'regur soil' (or the Black Cotton Soil). The largest concentration of the crop occurs in Broach, Khandesh, Berar and Tinnevelly, all in the Deccan tableland Outside the Deccan tableland the crop is found concentrated, though not to the same extent, in the Punjab This latter area is, however, essentially an irrigated cotton tract More than two-thirds of the crop is found in the States of Andhra, Maharashtra, Gujarat, Madhya Pradesh and Madras, and only one-fourth in the alluvial plains of the north. This shows to what an extent the Black Cotton Soil and the associated soils are a boon to the cultivator of the Deccan tableland in producing this money crop.

The soil is the dominant factor in the cultivation of cotton in India.

There are three main classes of cotton soils here.—

(1) Rich black loamy soils, as those of Kathiawar, Gujrat, Khandesh or Karnatak. These are collectively known as the 'Black Cotton Soils'.

(2) Mixed red and black stony soils, as those of the Deccan, Berar and Madhya Pradesh.

(3) Alluvial sandy soils, as those of the Sutlej-Ganga Basin.

Climate is the next important factor in the cultivation of cotton in India An idea of the suitable climate is given by the following graph:—

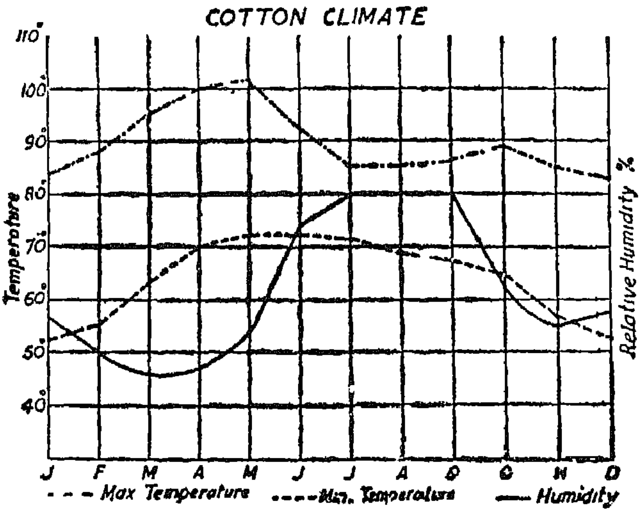


Fig. 21 Meteorological Observation at Ahmedabad.

Three things stand out prominently in the study of this graph —

(a) The period of growth of cotton, from July to September, is marked by uniformly high temperatures, between 70° and 85° F

(b) The period of high temperatures is accompanied by high humidity, generally 80%.

The combination of great heat and great humidity is particularly helpful for the growth of the cotton plant.

(c) From about October humidity falls off considerably, but the maximum or the day-temperature continues to be above 80° F This factor helps the ripening and bursting of the cotton bolls in the sunny skies that result.

It is also clear from the graph that from the month of March onwards the temperature conditions are suitable for cotton cultivation in India, but the moisture is deficient as is shown by the downward curve of relative humidity.

The influence of rainfall and the amount as well as the season when it comes, is of vital importance in the cultivation of cotton If the rainfall is considerable no cotton will be cultivated, even if the soil is suitable. For it encourages vegetative growth rather than fruit from which cotton is obtained

Provision of cheap labour is another important factor in the cultivation of cotton in India. Cotton-picking must be done by hand, the picker paying attention to the fully open bolls only.

Southern India, with its two rainy seasons possesses two widely different cotton crops.

A reference to the rainfall map will show that most of the cotton in India is grown in areas which have a rainfall of 20 to 30 inches per year The picking season over the main cotton-growing area, that is, from November to February, is practically dry

The most favoured localities for growing the finest Indian cottons are Surat, Broach, Ahmedabad and Kathiawar.

The main areas for cotton cultivation in Maharashtra and Gujarat ore Ahmedabad, Broach, Surat, Karnatak, Dharwar and Khandesh In Broach, the soil is deep and retentive of moisture The 'Black Cotton Soil' in some parts is about 5 feet deep. Over the greater part the annual rainfall exceeds 35 inches (90 cms) The crop is sown as soon as possible after the monsoon sets in It is grown alone, but where the rainfall is heavy and the soil retentive (as in Broach) rice is grown with it. The principal associated crop with cotton is, however, Jowar The flowering begins in October-November and the picking generally starts in January, lasting till March or April.

The cultivation is slightly modified due to the monsoon in Karnatak, Dharwar and Khandesh If sowings were done in June, as in other districts, the crop would ripen here in the middle of the north-east monsoon and be damaged by rain. To prevent this, sowing usually starts in the later part of August.

In Khandesh two different types of cotton are grown, the one on the heavy black soil and the other on light soil The light soil crop yields best with heavy rainfall, and the black soil crop with moderate rainfall.

In Madhya Pradesh sowing of cotton commences with the rains in June. Picking starts in November and is finished by March.

There are two forms of indigenous cotton usually grown in Madras, one depending on the south-west monsoon, the other on the north-east The former crop is sown between May and July, and the latter between September and November In Tinnevelly both are sown in the same season, October to November In the Tamil country where cotton is produced both on black soil and red soil, the crop is sown in black soil during the south-west monsoon when the rainfall is not heavy; and in the red soil, which is a lighter soil, during the north-east monsoon when the rainfall is heavy.

Outside the Peninsula irrigation plays an important part in cotton cultivation Sowing of the crop does not, therefore, wait for the rains in the areas where irrigation facilities are available In areas where such facilities are not present, however, the sowing can be done only with rains The period of sowing thus varies from March to August. In the Punjab, owing to the danger of frosts, the picking is completed by about January.

Among the indigenous varieties of cotton grown in India, the Broach cotton is the best The Broach tract extends northwards from the river Par up to the southern boundary of Ahmedabad district It is one of the most important cotton tracts of India and at one time was the most important. It has now lost its impor'ance considerably owing to the infiltration of important varieties are: Omras, grown in Berar, Dholeras ties Broach cotton yields the finest and the longest fibre Other important varieties are Omras, grown in Berar, Dholeras grown in Gujarat, Dharwar grown in southern Bombay States and the Bengal, inferior to all, grown in Northern India. Practically all the indigenous varieties have a short and coarse staple. Certain types of cotton have been imported from foreign countries and crossed with Indian varieties to produce better varieties yielding finer and longer staple Among these improved cotton may be mentioned the Combodias grown in south-east Madras, and Punjab-Americans grown in south-west Punjab With the growing demand for finer cottons in India, all efforts are being made to improve the quality.

The area under cotton in 1958-59 was 199 2 lakh acres, in 1960-61, 188.7 lakh acres and in 1961-62, 187 1 lakh acres The production of cotton (lint) was 46 8 lakh bales in 1958-59, 53 9 lakh bales in 1961-1962 The II Five Year Plan target of cotton production was 65 lakh bales which has not been achieved even till now.

Cotton in India is bought and sold, in common with many other agricultural products, on the reputation for quality of its place of growth The difference in quality of cotton that exists between the same or different types of cotton grown in different tracts has always been a source of temptation to unscrupulous people Measures have been taken under the above act, and other acts, to eradicate inferior cottons from certain protected zones. There are now seven such zones in Bombay, two in the Madras State and one in Madhya Pradesh

The average yield of cleaned cotton per acre in India is very low, only about 90 lbs per acre. This is very low when compared with the Egyptian average of over 400 lbs and the American average of over 270 lbs It is seen that the yield of irrigated cotton is much better than that of unirrigated cotton. In Madras, for example, the average yield of irrigated cotton is 250 lbs per acre while that of unirrigated cotton is only 73 lbs Most of the cotton crop in India is, however, unirrigated. The largest cotton acreage irrigated is outside the chief cotton zone. Practically no cotton grown in the Black Cotton Soil region is irrigated. The largest area of irrigated cotton is in the Punjab, South-eastern Madras and U P.

An important point about cotton cultivation in India is that the cotton fields, unlike those in America or Egypt, in a large majority, produce a grain crop after cotton has been harvested The field is, therefore, cleared before all the cotton has been picked The total outturn is affected adversely in years in which the monsoon rains start late For it must be borne in mind that the sowing of indigenous crop in Black Cotton Soil area particularly, and elsewhere generally, is done with the first monsoon rains A large proportion of the buds (bolls) of improved variety which produce longer staple, as well as, of the indigenous cottons, never get a chance to open, owing to the falling off of temperatures in December The Black Cotton Soil area and the South generally have an advantage in this respect There the winters are warm with bright sunshine and cotton picking goes on during winter and even up to July in some cases

COTTON

Extent of Cotton Cultivation in India

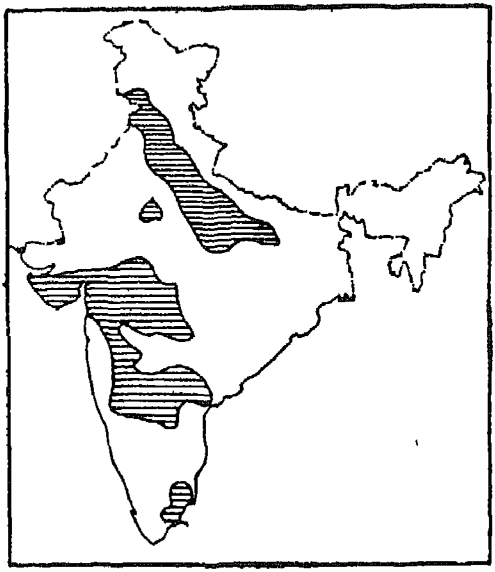


Fig. 22. Cotton growing areas

Area and production of Cotton in India

Year	Area (in 000 acres)	Production (in 000 bales)
1950—51	1,45,36	19,10
1955—56	19,981	3,998
1957—58	19,804	4,744
1958—59	19,926	4,686
1959—60	18,804	3,678
1960—61	18,971	5,394

(1 bale=392 lbs each)

The production of cotton at the end of Second Five Year Plan was anticipated. to be 5.4 million bales *i.e.* 1.1 million bales

short of the target. The Third Five Year Plan target has been kept at 7 million bales to be produced by the end of 1965-66

Since the beginning of the present century the home consumption of raw cotton in India has been increasing. The average consumption of Indian cotton in Indian mills during the period from 1937-38, 1955-56 was about 27 lakh bales. In 1950-51 this consumption was 36 lakh bales and 49.6 lakh bales in 1958. The greater part of this consumption is of long and medium staple cottons.

The following table gives the consumption of cotton (Indian and foreign) by the Indian mills.—

(*In million bales of 400 lbs. each*)

Year			Indian Cotton	Foreign Cotton	Total
1946-47	.	.	2.14	1 72	3 86
1948-49	..	..	2.12	1.13	4 25
1951-52		.	2.99	1 08	4 07
1954-55	..	..	4.14	0·63	4·77
1955-56	..	..	4 37	0.60	4·97
1957-58	..	..	4.69	0 56	5·26
1958-59		..	4.62	0 45	5 07

Although the United States is the world's leading producer of cotton, it buys some of our cotton The United States does not grow the rough, white short-staple cotton used for manufacturing cotton and mixed cotton-wool blankets. Some American cotton is used for the manufacture of cotton blankets, but it is admitted to be not as suitable for this particular purpose as the imported Indian cotton. Moreover, American cotton, unlike the rough short staple cotton does not mix with wool, and therefore, does not lend itself to the manufacture of cotton-wool blankets which are popular in those parts of the United States where the temperate climate precludes the use of all-wool blankets Indian cotton is also used to a comparatively small extent as padding in clothing

The important qualities of short-staple cotton imported into the U.S.A. are its roughness, cleanliness and whiteness Until recently, China, (especially North China), and India were the two main sources of supply. The Far Eastern hostilities, however, led to the practical elimination of China as a source of supply This considerably improved the position of Indian short-staple cotton in the United States during the war.

India exported Rs. 2120 lakh and Rs. 1637 lakh worth of raw cotton (Short-stapled) to foreign countries in 1958 and 1959 respectively. This was sent mainly to U.S.A.

India also has to import cotton (long stapled) from U S A. and Egypt for the manufacture of fine cloths In 1958 India imported Rs. 3066 lakh worth of raw cotton and in 1959 Rs. 3476 lakh worth, from foreign countries

2. Jute

India has suffered most in the supply of jute due to partition than cotton, the other fibre crop. Out of the 23 lakh acres under jute in India in 1947, more than 18 lakhs went to Pakistan. The best districts for jute, Mymensingh, Dacca, Rangpur, Bogra and Pabna all bordering on the Brahmaputra and affected by its floods, which deposit large quantities of fertile silt, now form part of Pakistan The result has been that in 1951-52 while Pakistan produced about 68 lakh bales, India produced only about 46 lakh bales The old Brahmaputra or the Jamuna in Pakistan also provides clearer water for retting the jute than the Ganga. The cultivation of jute decreases towards the south in the Ganga Delta where the land is too low for jute, and towards the west where the rocky ground of the Deccan plateau is more marked than the Ganga alluvium.

The production of Jute in the following provinces is as follows.

	55-56	58-59	59-60	60-61
Assam . ..	1,212	986	1114	813
Bihar ..	589	1,243	956	839
Orissa	245	177	212	261
U P. ..	89	95	92	89
W. Bengal ..	2,013	2,596	2,170	1,987
Tripura ..	50	58	60	41

(production in thousand bales)

Jute is generally grown on raised ground provided by the old or new river levels. In the depressions rice and jute are often rotated The best quality of jute is obtained from loamy soils. Clayey soils give the heaviest yield, but the plants grown in such soils do not ret uniformly. Sandy soils, on the other hand, produce coarse fibre. Climatic conditions are, however, of more value to jute than the composition of the soil. A hot damp climate, in which there is not too much actual rain, especially in the early part of the season, seems to be best for it.

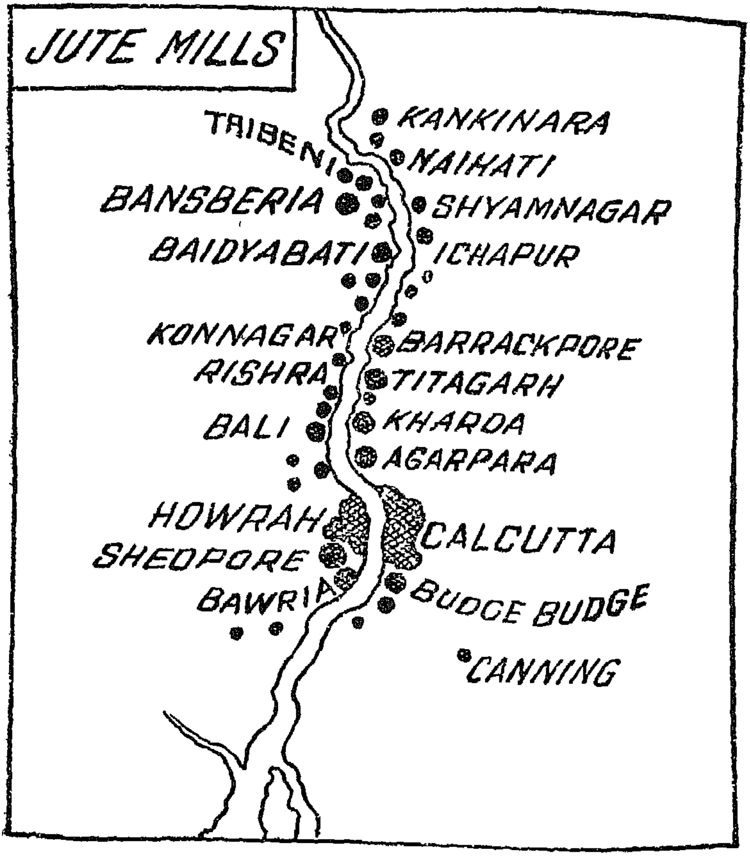


Fig. 23 Location of Jute Mills along Hoogly river in West Bengal

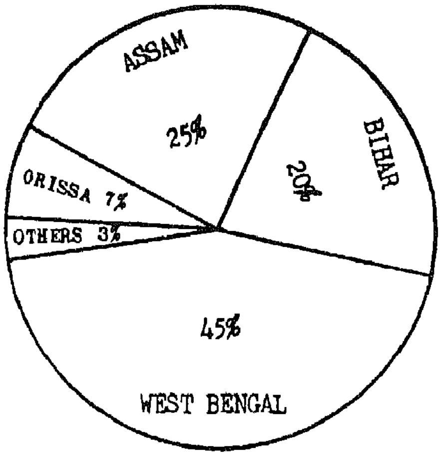
There are two main varieties of jute plant grown in India, Chinese and Indian. The Chinese variety is chiefly grown on *CHARS* or mud-banks and islands formed by the

rivers The Indian variety grows chiefly on BIL or completely submerged lands even on salt-impregnated soils, such as those of Sunderbans These varieties are, however, found growing together in many parts of India

The character of the land, whether it is upland or lowland, determines the sowing period of jute When it is to be grown on lowlands, subjected to flooding, sowing takes place earlier than on raised land Thus, on BIL lands it is sown from February to March and on raised land from March to June The time for harvest depends largely on whether the crop is an early sown or late sown The harvesting season starts for the earliest crop about June, the average season from all crops being August to the end of September.

The districts which have a heavy annual deposit of silt have a superiority over others which have little or no silt deposit, especially because manuring is not commonly practised in jute cultivation.

JUTE



STATE DISTRIBUTION

Fig 24

India had a world monopoly of jute before partition. It must be remembered that the largest consumption of jute is for packing material. Cheapness, durability and strength are not

found in any other packing material as tin jute. Efforts have been made in other countries to find substitutes for jute, but without success. To increase the supply of raw jute in India the area under jute is being increased The following table gives figures for acreage and production in India —

Year	(Lakh acres)	(Lakh Bales)
1958—59	18 11	51 6
1959—60	17 07	45 5
1960—61	15 29	40 3
1961—62	25 59	62 69

The largest increase has been in Bengal, Bihar and Assam. Jute has also been introduced in Kerala and U P (Terai)

In order to improve the quality of jute the Government envisages the setting up of 18 State farms for the production of good quality seeds, of which 3 are to be in West Bengal, 3 in Bihar and 1 each in Uttar Pradesh and Orissa

In view of the dearth all over the jute-growing States of retting water which constitutes singly the most important factor in influencing the quality of jute fibre, the Government of India has accepted the three-year scheme for constructing 8,200 new tanks and re-excavating 4,300 old tanks.

Under the Third Plan the production of Jute is expected to go up by 55% *i.e.* it will increase from 4 million bales to 62,00,000 bales by the end of 1966 This excludes Masta of which 13,00,000 bales are supposed to be had by the end of Third Plan.

For the year 1961-62 India exported a sizable amount of Jute manufactures to various countries of the world and earned foreign exchange to the tune of Rs 1403 million Following is the percentage of Jute exports :—

U S. A	36.6%	U. S. S. R.	2.9%
Canada	5.5%	Bahrein Isles	2 1%
U. K.	4.7%	Egypt	1.5%
Argentina	3.3%	Australia	1.4%
	others 2.0		

MISCELLANEOUS CROPS

Besides the crops mentioned above, a large number of miscellaneous crops are cultivated in India. These crops are, more or less of local importance only Unlike the agriculture of the Cool Temperate lands, miscellaneous crops are a special feature of tropical agriculture all over the world

Fruits

The cultivation of fruits and vegetables does not form an important part of Indian agriculture. Hardly 2 p c. of the total net area sown in India is under fruits and vegetables. By far the largest proportion of this area lies in the Ganga-Brahmaputra Basin It increases as one proceeds down the Ganga. U.P has about 1 p c of its total net area sown, under vegetables and fruits, but Bihar has 2 5 p c., Bengal 3 p.c and Assam 6 5 p.c.

Among the fruits the mango, the plantain and the coconut are most important The mango is a speciality of the wet, alluvial regions of India. The middle valley of the Ganga is more famous for it than any other part of India Within recent years, the mango plantation has spread in canal-irrigated areas of the western section of U.P and the Punjab also. In the fertile parts of the Deccan also it has been planted. Mysore, Hyderabad and Madras have now become important for it Outside the Ganga Valley, Bombay is also important for mangoes The importance of the mango fruit in supplementing the food supplies of the rural areas is considerable The internal trade in better varieties is now increasing, owing to railway facilities.

Just as the mango is essentially the fruit for the north, the bananas and the coconut are the fruits of the south. The coconut is, however, commercially more important, as it is not easily perishable as the mango or the banana. The wetter parts of the Peninsula, especially the Malabar coast, are very important for the banana and the coconut

Citrus fruits, especially the orange, are grown all over India, but there are certain areas where the fruit is grown more intensively than in others. Among these areas of intensive cultivation are Nagpur, Assam, and isolated areas in the lower Himalayas, as for example, Sikkim and Butwal.

The deciduous fruits, *i.e.* the apples, are grown in the drier and cooler parts of the Himalayas, especially near the Punjab The Kulu and Kashmir valleys are the most famous.

With the growth of the urban population and the health propaganda for eating more fruits the cultivation of fruits has considerably increased within recent years.

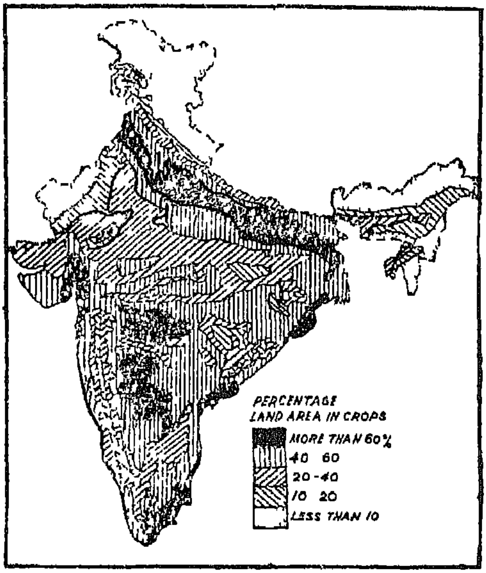


Fig. 25 Showing % Land Area in Crops.

FODDER CROPS

Fodder crops also are not of much importance in Indian agriculture. The pressure of population on land and the insignificance of meat in Indian diet preclude the fodder crops from the general system of agriculture here The Indian cattle on whom rests practically the whole of the burden of agricultural operations are given as fodder the by-products of the main crops They are, therefore, weaker than the cattle in Temperate lands where the systematic cultivation of the fodder for the cattle is as important as the food crops for man The peculiarities of the Indian climate do not enable hay-making The Indian grasses, growing rapidly in hot and moist season, become tough and are not succulent so that the cattle generally do not relish them when they are dry. Besides, the area left over for grass is generally infertile where grasses are short and not fit for hay-making.

There are two important points about Indian agriculture; the pressure of population on land and the general low yield

per acre The pressure of population has been increasing steadily due to the increase in India's population. This has naturally given cause for anxiety and the question has been raised recently whether India's agricultural production can be increased

ANIMAL HUSBANDRY & LIVESTOCK

The Dairy Industry or other forms of animal industry, like meat-packing, have not developed on any large scale in India. The urban population which offers the largest market for these industries is not large in India. The number of animals yielding milk is, however, very large in India These animals are kept for breeding bullocks and buffaloes that are needed for agricultural operations. Their main purpose, therefore, is not milk production but to help agriculture. The milk yielded is used mostly for making ghee which is sold in cities. The quantity of ghee made is estimated to be about 12 lakh maunds. Of the total milk produced in India, about 38% is estimated as being used for consumption as fluid milk, about 42% as ghee and the rest as butter, khoa, curd, and other products. For want of large grazing areas. the dairy cattle are generally stall-fed This is particularly so in large cities like Calcutta and Bombay The largest number of milk yielding animals is in U P., where the area under cultivation is the largest in India, and therefore, the need for cattle help is very great.

The animal most used for slaughter for meat is the goat The largest number of goats are in U P and Madras The number of sheep in India is 39 million, but owing to the hot climate they do not produce good or fine wool here In the Himalayas, where alone good wool is produced in India, the goat is more important as a wool producer than sheep. The following table gives the numbers of some animals in India according to 1961 Census.

Cattle	17 57	lakhs
Sheep	403	"
Goats	608	"
Buffaloes	511	"
Horses and ponies	13	"
Other live-stock (mules, donkeys, camels and pigs)	73	"
Total Live-stock	3365	"

There is provision of about Rs. 54 crores in the 3rd Plan for animal husbandry aimed at developing the milk-yielding capacity of well-defined milk breeds by selective breedings and upgrading of nondescript cattle and improvement of draught breeds in milk without impairing the quality of the bullocks The above aims are to be achieved through Key village scheme, Gaushala Development Scheme, Gosadan Scheme etc

The All India Key Village Scheme initiated during the First Plan, aims at progressive improvement both in the milking and working capacity of India's cattle population. The scheme has been expanded in the Third Plan and new measures like the establishment of Central Semen collection centres. inservice training centres and setting up of marketing cells in the Animal Husbandry Deptt have been proposed for effective working under the Third Plan A sum of Rs 5 19 crores has also been earmarked for this purpose The various State Governments are on the spur to see that the Key Village Blocks take up intensive cattle development work and rural dairy extension programmes.

The Key Village scheme aims at progressive improvèment both in the milking and working capacity of India's cattle population There are about 25 breeds of cows and eight of buffaloes, in addition to a large number of animals which do not conform to any well-defined set of characteristics It is possible that by proper methods of breeding, animals of the draught category can additionally become good milk-givers and, after all, what the average cultivator needs is a good dual-purpose animal In the immediate future to improve the milk supply in urban areas cattle colonies and co-operative milk unions have been established Rural creameries and milk-drying plants in surplus pockets of the country have also been set up.

At every Key village attention is paid to the proper feeding of cattle, control of contagious diseases and marketing of the cattle themselves and their produce such as milk and ghee Government provides these services free of charge at the cultivator's door.

A calf rally is annually held in each group of four Key villages, and prizes are given for the best reared animals These are occasions for village gatherings of both educative and entertainment value

Fodder development scheme. This scheme aims at the establishment of fodder and pasture demonstrations plots in villages, distribution of fodder seeds and planting materials

to the farmers, popularising silage making, feeding of good breed cattle on balanced ration, improvement of pasture lands and livestock farms and opening of fodder demonstration-cum-training centres This programme is currently under operation in 11 states and 2 union territories

Calf Rearing Scheme. Under this scheme selected calves of 6 months' age and above are purchased from the cattle breeders and distributed free of cost to the cattle breeders, co-operative organisations etc. It is estimated that 2,409 calves were distributed in 1962-63 from Haringhatta and Aarey milk colonies

Gaushala Development Scheme. There are a number of Gaushalas in the country and through this scheme it is proposed to make use of these Gaushalas as cattle breeders and milk producing centres. During the Third Plan period 168 gaushalas will be taken up for development and in 1961-62 the number of gaushalas taken up were 22 only.

Gosadan Scheme This scheme aims at keeping uneconomic and un-productive cattle from areas where active cattle development work is in progress, to a place known as gosadan, usually established in remote forest area. It is proposed to establish collection centres during the Third Plan 3 Gosadans and 25 collection centres were set up during 1961-62

Stray and Wild Cattle Catching Scheme. This scheme is under operation in U P., Punjab, M P, J. & K and Delhi during 1962-63 up to Dec 31, 1962 it is estimated that 19,371 cattle were rounded up Of these 1,143 productive ones were distributed for breeding purposes and 5,077 unproductive ones sent to gosadans, Rounded up cattle are also being sent to Dandakaranya Project for increasing milk production in the area.

Improvement of Hide-Flaying,

Curing and Carcass Utilisation Scheme.

Bakshi-Ka-Talab, Lucknow (developed with the assistance from the Netherlands Government and the F A.O) imparts training in hide-flaying, tanning and footwear and leather utilisation.

Nomadic Cattle Breeders Scheme. This scheme aims at rehabilitating the nomadic cattle breeders in the states of Andhra

Pradesh, Rajasthan, Uttar Pradesh and Gujarat. It is also proposed to provide better breed's bulls and veterinary aids to breeders

Dairying At present there are 22 dairy plants including new ones installed at Calcutta, Hissar, Madras and Srinagar. Besides 13 new dairies are also taking shape at different places Pilot milk schemes have been introduced in a number of cities It is estimated that about 8.5 lakh litres of milk are being handled daily.

In addition to Haringhatta and Madhavaram cattle colonies, a new colony near Bombay is to be set up very shortly. At Anand a cattle feed compounding factory is also taking shape

The Amritsar dairy project commissioned in Dec 1962, for marketing of 20,000 litres of milk daily and manufacturing 1,500 tons of spray-dried skim milk every year. Similar factories are also being set up at Aligarh, Barauni, Junagadh and Rajkot

Training in dairying has been taken up at Aarey, Allahabad, Anand, Bangalore and Karnal with the collaboration of UNICEF. At Anand a students' dairy has been established and very shortly similar ones will follow at various places The National Institute of dairying at Karnal is conducting courses in dairy engineering and extension with the assistance from F A O. and Denmark.

Piggery Development Scheme. At Aligarh (U P) and Haringhatta (West Bengal) regional pig breeding stations are in operation. Besides two more regional pig breeding stations-cum-bacon factories are proposed to be set up in Andhra Pradesh and Maharashtra This will involve an expenditure of Rs 15 lakhs each 10 piggery development blocks and 5 pig breeding stations have also been set up in Assam, West Bengal, Bihar, Kerala, Madras, Punjab, U. P , Delhi, Himachal Pradesh and Manipur during 1961-62

Poultry. In order to give incentive to commercial poultry farmers the government has established 7 intensive poultry development blocks and 5 feed manufacturing units Besides 3 new centres have also been set up for collecting, grading and distribution of eggs At Gurgaon (Punjab) a big commercial firm has started supplying high quality breeding stock with foreign collaboration. It is proposed to set up similar farms at various other places in different states.

SPECIES OF CATTLE

There are at present forty recognised breeds of cattle and buffaloes in our country. In India certain breeds of cattle are known for their high milk production, while others for their high class powers A third category of animals combines in themselves a moderate degree of efficiency for production of both milk and work Some of the best varieties are mentioned here—

(1) Some of the best cows in India are Sahiwal in Punjab and Gir in Saurashtra Red Sindhi whose habitat is in Sind (Pakistan) has been developed in Coorg and at Government farms of Karnal Hosur and Kolla It is a milch breed and cows are one of the best and economical producers of milk.

(2) The important breeds of bullocks are Hissar and Hansi found in Punjab and Nellore in Madras Amrit Mahal is one of the best draught breeds found chiefly in Mysore State Bullocks of this breed are active and fast trotters Ongole bullocks are powerful and suitable for any work Home of this breed is Nellore and Guntur districts of Madras Other breeds are Kanrej in Gujarat, Kangayam in Madras, cash business Where the treasury business is done by the State *Kherigarh in* Uttar Pradesh, *Dungi* and *Nimar* in Bombay and *Hariana* in Punjab The finest dual purpose animals, *i.e.* best for draught as well as milk purposes are *Kanrej* and *Gir*. The best breeds of buffaloes are *Murrah* in Punjab, *Jafferbadi* in Saurashtra and *Mehasana*, *Surati* and *Pandharpuri* in Bombay These nine breeds of cattle from all parts of India are of first rate importance·—

Sindhi. This breed hails from Sind, but several pedigree herds of it have been established in India, particularly in Kathiawar on the West Coast It is a distinctive dairy animal

Sahiwal. Though originally belonged to central undivided Punjab, it is available in Karnal, Uttar Pradesh and Madhya Pradesh

Hariana The home of this breed is the area covered by the districts of Rohtak, Hissar, Gurgaon, part of Karnal and the Delhi State This breed is also produced in more or less pure form in Jind, Nabha, Patiala, Jaipur, Jodhpur, Loharu, Alwar, Bharatpur and in East Uttar Pradesh

Murrah. The cows of this breed are good milkers and the bullocks are excellent for draught It is available in Southern Punjab, Delhi and Northern Uttar Pradesh.

Gir. The home of this breed is Kathiawar. Pure specimen of this breed is available in Junagadh.

Kankrej. The home of this breed is the country to the south-east of the Rann of Kutch, extending from the south-west corner of the Tharparkar district in Sind to Dholka in Ahmedabad district, also along the Banas and Saraswati rivers It is one of the heaviest of Indian cattle

Tharparkar. Coming originally from the arid semi-desert tracts of south-east Sind, this breed is mostly bred in India today to the north-east portion of Bombay State as well as Marwar.

Kangayam. The name of this breed is derived from the Kangayam division of Coimbatore district where it has been in existence for a long time.

Ongole. The home of this breed is Ongole tract of the Madras Presidency comprising Ongole, Guntur, Narasaraopet, parts of Bapatla, etc

It is a significant fact that good cattle are generally found in dry areas and inferior cattle in areas of heavy rainfall The rainfall map of India more or less coincides with her cattle map

Thus Punjab, Rajasthan, Saurashtra, Mysore and drier parts of Bombay and Madras are homes of some of the best cattle in India, while non-descripts are found in areas of heavy rainfall, like Assam, Bengal, Orissa and Malabar Coast

Sheep. Another cattle wealth of India is sheep and goats Their distribution is widely divergent mainly dependent upon the climatic conditions—the number being smaller in heavy rainfall areas and greater in light rainfall areas. There are in the country about 38 million sheep some of which are mutton variety and some of the woolly type The annual clip of wool is about 38 million lbs valued about Rs. 9 crores The wool which is one of the main products of the sheep breeding industry, holds eighth position amongst the agricultural commodities in the country's export trade and earns 54 million rupees in foreign exchange The sheep do not only provide wool, but also mutton,

manure, pelts, hair, milk, butter and serve as pack animals to carry essential foodgrains from their owners, across the precipitous hills where other systems of transport would perhaps fail.

There are about 14 breeds of sheep in India, which can be divided into two distinct types, namely, woolly and hairy The woolly types produce wool fibres of fine or coarse quality, while the other just produce hair and are reared for manurial purposes and to provide mutton

The carpet wool produced in India is classified in the world markets as East Indian type of wool and is sold under well-known names of Joria and Bikaneri. The Bikaneri breed hailing from the desert of Bikaner is the hardiest breed known in India This breed is becoming a cosmopolitan breed of India and is being introduced in different States The fact that India is one of the main producers of carpet wool, need not leave an erroneous impression that India produces only this wool This country also produces large quantities of fine wool, specially in the hills of the Punjab, Uttar Pradesh and Kashmir But this does not meet the requirements of our country, with the result, that we have to import about 9 million lbs of fine wool every year. There are several types of hill-sheep along the Himalayan ranges which produce fine wool, such as Gurez, Karnah, Bhadasweb, and Ramput Busher The story of Indian hill-sheep will remain incomplete without the mention of Pashmina goat coming from Ladakh, Kashmir This goat produces the finest wool in the world, known as Pasham. We have also Tibetan sheep coming to Indian hills in summer Merino sheep are being introduced in our hill areas to improve the local sheep as to get more and fine wool from them.

The wool-producing States are the Punjab, U P , Rajasthan. The average production of wool per sheep in India is 1 9 lb. There is an Wool Analysis Laboratory in Poona, for the research of wool fibre and various other improvements The annual production of wool of Indian sheep is very poor when compared to those of other countries The wool produced in India is also of much inferior quality. As an exception, the Kashmir goats are famous for fineness of their wool There are some good sheep in parts of India like the Bikaner rams which are woolly types

Goat is also the principal source of meat-supply in the country. The important varieties of goat are—Jamnapari type of the Deccan Plateau, the Surti of West India and the black and white bearded variety of Bengal, Ganjam, and Telingani varieties

India's goats number about 6.08 lakhs. Goats are prized for their meat and milk Goat contributes only 3 p c. of the total milk supply of India.

FISHING

India, with a coastline of 5635 miles, into which numerous large, perennial rivers discharge their silt-laden waters, innumerable gulfs, creeks, bays and oceanic islands, has a fishable area of about 283800 square kms Similarly, the extensive backwaters, estuaries, lagoons and swamps, numerous rivers, streams and channels and a very large number of perennial and semi-perennial lakes, beels, reservoirs, tanks, ponds and other stretches of water, a large proportion of which is culturable, are a rich potential of inland fisheries So far as sea area is concerned only a small portion is at present worked This, it is stated, is because the methods used by Indian fishermen are not modern, most of them using country boats like catamarans and small nets which are not adequate for fishing in deep seas The chief sources of supply of fish are the coastal margins of the sea, river estuaries and backwaters for marine and estuarine fish and rivers, canals, tanks, inundated tracts, etc for the fresh water fish

Inland Fisheries constitute fresh fish from rivers, canals, tanks, ponds, irrigation channels, inundated tracts, etc They are the mainstay of inland fisheries of India The extensive areas of Ganges system, Brahmaputra, Mahanadi, Nardama, Godavari, Krishna and Cauvery are the main areas for inland, fisheries In this class of fish, West Bengal leads the rest of India. The three states namely West Bengal, Bihar and Assam account for 72 per cent of the total fresh water fish in India

See Fishing. Sea fishing is mainly carried on in small craft having a displacement of under five tons, in coastal water from five to seven miles from the shore and within a depth of 10 fathoms With the exception of a few off-shore fishing boats operating in certain localities, very few fishermen make voyages which would entail staying in the open sea longer than 12 hours at a time There is, at present, practically no night fishing This is largely because the equipment used for sea fishing consists mostly of boats, canoes, catamarans and of small nets and tackles which are not a type which can stand the rigours and requirements of off-shore or deep-sea fishing These fishing people, poor as they are, have acute problem of procuring nets, timber for boats, sailing cloth, fish hooks and coal tar, etc So the mechanisation of fishing operation has become an absolute necessity. There are at present 2,400 mechanised boats.

At present sea fishing is carried on within 10 fathoms in the sea The sea fisheries are confined to the coastal waters from the shore of Gujarat, Canara, Malabar coast, Gulf of Manar, Madras coast and Coromondal coast.

Plans are ahead to construct fishing harbours at Karwar, Beypore and Cannanore (Kerala) Kakinada (Andhra Pradesh) and Royapuram (Madras) while 2 such harbours are already functioning at Cuddalore and Veraval

The Principal sea fish around the coasts of India are herrings, mackerel, prawns, jew fish, eat fish, mullets, pomfrets and Indian salmon Mackerel accounts for over one-third of the total catch Herrings account for over 15 p c of the total catch Prawns account for 9 p c of the total catch.

Estuarine and Backwater Fishing. Chilka lake in Orissa, backwaters in Madras, Cochin and Travancore, deltaic areas of Sundarbans and Mahanadi are the principal sources of estuarine and backwater fish The estuaries of Mahanadi and the Ganges stretching from Puri to Hooghly are extensive fishing grounds containing hilsa, pomfrets, prawns, catla cat fish, rohu, etc

Refrigeration. Another important item for the improvement for fish production in India is the refrigeration without which this problem cannot be solved. At present, though large quantities of fish are being caught, but for want of refrigeration facilities and transport, only a small portion of the catch can be used in a fresh condition So for the better supply of fishes, two things are absolutely necessary—(1) quick transport of fresh fish from large assembly centres to some of the towns in fast motor vans, (2) provision of refrigerated rail transport For the quick freezing and cold storage, erection of cold storage plants are the ideal solution for the proper preservation of fish and also erection of as many ice factories as possible, so that adequate quantities of ice may be available at all important fishing and consuming centres.

Fishing Industry. (1) There is practically no fish-canning industry in India but fish curing is being carried on in various ways In India fish is preserved by desiccation with or without salt and by the use of antiseptic preservatives, such as brine, vinegar, etc. The main process is the desiccation by drying fish in the sun It is also done by salt Canning is practised on a limited scale in Madras and Bombay The cured fish has developed lucrative export trade with Ceylon and other countries. Fish curing yards have been established along the coasts of

India. In order to develop fish industry in India on extensive scale refrigeration system has become absolutely necessary Cold storage facilities are being developed in every part

Varieties of Fishes More than 1,800 distinct species of fish are known to exist in the seas around the country and the inland waters, but the varieties that are caught in appreciable quantities are limited in number Pisciculture experts classify the commercially important varieties of sea fish into 15 groups and freshwater fish into eight

The sea fish groups include elasmobranchs, eels, cat fishes, silver bar fish, herrings and anchovies, Bombay duck, mackerels and perches, silver-bellies, flat fishes, mullets, Indian salmon which is stated to be not a true salmon, jew fish, crustaceans and minor shell-fishes

The total landing of marine fish by State

State	(in metric tons) 1957	1958
Andaman (South)	96	92
Andhra	40462	28846
Bengal (West) & Orissa North	4509	3593
Maharashtra and Gujrat	356660	222886
Kerala	309926	294655
Madras—		
(i) East Coast .	48592	55265
(ii) West Coast	31092	62791
Mysore .	76090	80242
Orissa (South)	3757	2674
Mechanised vessels . ..	4332	4730
Total .	875516	755774

Fresh water fishes are grouped under cat-fishes, mullets, carps, prawns, murrels, feather backs, eels, herrings and anchovies. Though several kinds of edible fish are obtained from fresh water sources, only a fraction of the inland water area is devoted to planned pisciculture

Regarding fresh water fishes, carps form the most highly esteemed variety, constituting about 34 per cent such as Rohu, Catla, Mrigal and Calbaus which are well known throughout

India Other important varieties are cat fish, wallgo, bargarious. clarius, silundia and macrones belonging to this class. Trout has been introduced into the hill streams in Kashmir, Kumaon and Nilgiri Hills.

Regarding river fishes, the following may be specially mentioned—mahseer available in the upper reaches of most rivers in India Chilwa is a flat-sided, thin-bodied fish with his stomach running an edge It occurs freely both in the north as well as in south Indian rivers Murrel varies from 2 to 3 ft in length Batchwa is small but excellent for eating Barils have 14 species and they are widely distributed throughout India Olive carp is available in Madras and is also found in the fresh waters all along the coast of India from Kutch to Bengal. Mulley has no scales.

Regarding tank fishing we have rohu which is met with in most large-sized tanks

The following table shows the production of fishes in India (1957) by species.—

Groups and species	1957 ('000 Metric tons)
Marine fish	
Flounders, halibuts, soles, etc	3.6
Cods, hakes, haddocks etc	1.1
Herrings, Sardines, anchovies etc	292.9
Tunas, bonitos, mackerels etc .	139 3
Miscellaneous marine teleosteans ..	278.3
Sharks, Rays, skates etc ..	23.0
Crustaceans ..	136.8
Total marine fish .. .	875.4
Fresh water fishes	357 6
Total of all fishes .. .	1233 0

Fish Products. Besides articles of food, fish yields several by-products, such as fish-oil, fish-meal, fish-manure, fish-maws and shark-fins. The most important is fish oil, such as, cardine oil and shark-liver oil which are now produced on commercial basis in India The oil is used for the manufacture of paints, soft-soaps, for softening hides, for tempering steel, batching jute and after hydrogenation for the preparation of edible fats Fish liver oil produces vitamins A and B indispensable for wasting diseases It is being manufactured by the Governments of Bombay, Madras and Travancore The Government shark-liver oil factory is situated at Kozhikode, Madras which supplies shark

liver oil for use in hospitals and for sale to the public Indian fishes such as salmons, jewfishes, cat-fish are yielding Ising-glass, a valuable article for the clarification of wines. Bombay, east coast of Madras and Sunderbans in Bengal are the centres of trade of this commodity. Fish-scraps are converted into fish-meal as additional protein food for poultry and livestock Fish refuse is being dried as fish-manure

Fish-curing is also an important supplementary trade This chief method of curing fish in India are sun-drying and salt curing, either by dry or wet process.

Rate of Consumption. The average per capita annual consumption of fish in India is estimated at 3 98 lbs Travancore has the highest consumption of 21 lbs per capita a year, which comes to about one ounce per capita a day Other States which consume considerable quantities of fish are West Bengal 13 lbs per capita a year Madras 12 lbs, Bombay seven lbs., Assam six lbs and Orissa five lbs Consumption is the lowest in the Punjab with 0 08 lbs

In the FAO surveys India has been included in the category of low fish-consuming countries whose average per capita consumption falls below five kilograms India's neighbour, Burma is among the fish-consuming countries with an average of 20 kilograms per capita.

Nutrition experts estimate that for a balanced diet 1.3 ounces per day is required per adult *i.e.* 20 lbs. per capita per annum.

Approximately 92 per cent of the total production in India is used for edible purposes and eight per cent for the manufacture of industrial and other products.

The following table gives the production and disposal of fish in India for some years —

Year	Total catch	Fresh consumption	Sun dried	Salted
1956	9.96 3	4,25·5	2,58 1	247·0
1960	11,14 6	5,46 8	2,64 9	234 0
1961	9,45.9	4,53·2	2,19·4	193 9

(in thousand tons)

Total catch of fish amounted to 12 lakh tons in 1957 which declined during 1961 by 2 5 lakh tons This fall in production was mainly due to failure in sardine and mackerel fisheries.

During 1961-62 approximately 15,457 tons of fish and valued at Rs 3.91 crores were exported and at the same time 20 346 tons of fish and fish products were imported at a cost of Rs. 3 87 crores.

To train persons in fishing trade and development the government has established Central Inland Fisheries Research Institute at Barrackpore For sea fishing there is another centre at Mandapam Camp known as Central Marine Fisheries Research Institute Besides, there are other stations which conduct exploratory surveys for charting new fishing grounds These are at Bombay, Cochin, Tuticorin Visakhapattam and Mangalore. To evolve efficient mechanical devices two new stations have been set up at Cochin and Ernakulam The Central Institute of Fisheries Education at Bombay imparts training in advanced fishing technology. Apart from that 10 new extension units 14 fisheries are working at various places The State fisheries department and field staff of Community Development are also laying greater emphasis on trained personnel and efficient methods of fishing During the IIIrd plan schemes have been formulated to boost production and quick disposal of fish and fish production Measures have also been adopted to export a fair quantity of dried fish and fish product To improve the condition of fishermen measures are also being taken A sum of Rs 29 crores has been made for all these schemes and purposes, and it is expected that at least 4 lakh tons of additional catch will be obtained during the III plan and the export will be doubled.

Increase in population has resulted in a decrease in area of sown land per capita. It ranges from 0 77 in Assam to 2 07 in the Punjab and 1 95 in Bihar to 0 59 acres in Bombay.

India was facing great hardships at the time of launching the First Five Year Plan and she used to import huge quantities of foodgrains from foreign countries From 1946 to 1959 it is estimated that approximately about 2,40,00,000 tons of foodgrains worth Rs 1036 crores was imported Separation of Burma from the rest of India in 1937 came as a severe blow to the self sufficiency in foodgrains Prior to this India used to export 3 million tons of foodgrains every year and after Burma's exit India started importing grains which reached peak point of 1 5 million tons before the war period and 2.3 million tons after it ended.

As a result of proper planning, intensive research and continued efforts for the development of scientific techniques in agriculture, the food situation has improved to some extent and

our country has achieved self sufficiency in certain commodities, but still we are short of food and nearly ½ million tons of grain are being imported every year

The main reason for low food production in India is due to limited facilities and lack of proper agricultural implements and manures resulting in extremely low production per acre as compared to many other countries But as a result of five year plans and increased development activities success was achieved and during 1954-55 the food production exceeded the plan target by 5 million tons and 1 9 million tons in 1955-56. Besides, a lot of improvement was also noticed in the production of cash crops The marked rise in the producton of agricultural output was evidently due to intensive planning and during the Second Plan period great success was achieved.

Achievement of the Second Plan (1956—1961)

To improve agricultural output and increase the per capital income of the farmers a provision of Rs. 568 crores for agricultural and community developments were made during the IInd plan. It was planned to increase the agricultural output upto 52 8% by 1960-61 with the help of increased use of irrigation and fertilisers Greater emphasis was laid on intensive cultivation methods

As a result of the efforts carried out during the IInd plan period agricultural production in respect of food and non-food crops reached up to 69 million tons in 1956-57 in the very first year of the plan But in 1958-59 the production showed a record production Output of foodgrain reached 75 3 million tons, sugarcane 5 71 million tons, oil seeds to 6 9 million tons and of cotton to 47 lakh bales and of jute to 52 lakh tons. In '59-60 the production however fell by about 5% due to a number of reason for example draught and floods

Third Plan

In the 3rd Five Year Plan greatest stress was laid on food production but as a matter of fact little attention could be paid resulting in excessive low production over the past years We were importing food grains worth about Rs. 150 crores every year This resulted in increase of prices and cost of living It was therefore thought fruitful to plan an "Emergency Food Production" laying greater stress on food production during the entire period of the 3rd plan. It has been further recommended to accord credit facilities and proper arrangement of irrigation and manure. Further, it is intended to increase the irrigation area by 25 million acres This includes programmes for soil conservation, dry farming, land reclamation, flood control,

improve seeds and agricultural implements, use of manures and fertilisers etc.

Agricultural production in India can be increased along two directions.—

(i) Increased yield from existing fields

(ii) Cultivation of new lands.

(i) Increased yield from existing fields is possible only at a great expense of money. Intensive use of natural and artificial manures alone can considerably increase the yield from the soil. The money necessary for buying artificial manures, mostly from foreign countries, is lacking in India The Indian farmer is too poor to afford this The factory at Sindri produces about 3½ lakh tons of ammonium sulphate annually. But the total requirements of this manure for this country have been estimated at 15 lakh tons annually. The use of natural manure can be increased slightly by a change of habits At present cow-dung is used partly as domestic fuel This practice can be changed by using soft coke as a domestic fuel. It is not, however, easy to change overnight the habits of a people formed during centuries The Government is making efforts to convert into manure other kinds of refuse as well. Night soil and cow-dung and farm refuse generally are being made into "Compost". In 1949-50 about 10 lakh tons of compost were made in urban areas by the municipalities About 50 lakh tons of compost was made by the villages. In 1958-59, 26 4 lakh tons of compost manure was prepared from refuse materials as compared with 22.2 lakh tons in 1957-58 and 18.8 lakh tons in 1954-55, 18 3 lakh tons in 1953-54 and 17.5 lakh tons in 1952-53 The quantity distributed in 1957-58 amounted to 19 25 lakh tons as against 16 6 lakh tons in 1954-55, 17 1 lakh tons and 14 lakh tons in the preceding two years. A number of new schemes have been prepared for the utilisation of compost and it is estimated that these will give 14 million gallons of manurial water per day, irrigate about 14,000 acres and yield about 14,000 tons of additional production of foodgrains and vegetables. Thus the supplies of manure are being increased in India Mechanisation of agriculture has also been recommended for increasing food supplies in India.

It has been pointed out that about 730 lakh Indians produce crops from their agricultural land only as much food as about 70 lakh Americans do from theirs. The advantage of the Americans is said to be due to the farm machinery used in America. To modernise Indian agriculture, therefore, the Government of India has started a Central Tractor Organisation which possesses a fleet of tractors, agricultural implements and additional machinery. These tractors are working in different States of

India helping the farmer to produce more from his land The use of tractors is becoming popular in India since the Second World War. This will be clear from the increasing imports of tractors in the country During 1948-49 we imported tractors to the value of Rs. 1 9 crores and this value increased to Rs 7.8 in 1951-52. However, in 1954-55 we imported tractors to the value of Rs 3 9 crores The scarcity of farm animals and the higher cost of their maintenance, together with the scarcity and higher wages of agricultural labour naturally encourage mechanisation of agriculture. During 1951-52 to 1954-55, the area reclaimed amounted to 9 9 lakh acres During 1958, the C T O. reclaimed 39,000 acres of kans land and 3,000 acres of jungle land, besides carrying out levelling and terracing over an area of 4,000 acres, bringing the progressive total of area reclaimed by it since its inception to 16 67 lakh acres

The land reclaimed and brought under cultivation in 1957-58 was 5 25 lakh acres and it is expected to be 4 58 lakhs in 1958-59

An increase in the yield is also possible by using improved seed and better tillage with improved agricultural implements. Increased irrigation will also help Under Rabi Campaign, supplies of wheat seed and paddy seed were made available for M P , Bengal, Rajasthan and Bihar

Efforts are being made by the Indian Council of Agricultural Research to bring 22 million acres of land in the famine zone of India under improved cultivation by dry farming A comprehensive scheme of research in dry farming was formulated by this Council in 1930 But it was not until 1933 that funds were available for this purpose, and experimental stations were started in the provinces of Bombay, Madras, Hyderabad and the Punjab. In Bombay, improved methods were tried on the cultivators' own fields and the yield obtained was about double that obtained by the cultivator by his own efforts The results obtained at Sholapur and Bijapur showed that the average grain yield under the improved method after five years was about 90% higher than the one obtained by old methods

(ii) Most of the suitable land for agriculture has already been occupied There is, therefore, very little scope for finding new land for agriculture. The only areas where new land is available are the semi-deserts in the Rajasthan where the soil is fertile, but where cultivation is not carried on at present for want of irrigation facilities Gradually as these facilities are extended, some land will become available for agriculture This is the only important source of increased agricultural production in India

Besides, the Malnad, *i.e.* the country in south between the ghats and the sea-coast from Goa to Cannanore can also be made to yield crops In spite of the great geographical advantages like the fertility of the soil and the heavy rainfall Malnad is at present in a backward position because of excessive rainfall, unhealthy climate, prevalence of malaria, inadequacy of communication and scarcity of labour (as the density per square mile is below 200 to 300 persons). If these problems are solved, Malnad can contribute substantially towards the production of food-grains in the country.

Further, at present we have several million acres of cultivable wasteland infested by mosquitoes and malaria—such as in sub-Himalayan tarai, along Western Ghats and along Eastern Ghats. In these areas rice cultivation may be profitably undertaken as the rainfall is between 50-100" (125 cms. to 250 cms) per year Malaria affects man but not the soil Mosquitoes and rice plants are both sub-aquatic. It is possible to control mosquitoes and suppress malaria and to grow rice in these areas

Reclamation of barren lands may also be attempted, but here also the expense involved will not justify the small addition to the agricultural land in India. Experiments have been made and some are still in progress, in U P. and the Punjab for reclamation of the alkaline lands. The results have not, however, been encouraging

INDIA'S FOOD PROBLEM

The population of India is increasing at a considerable speed, but the area under food crops in India is either steady or decreasing owing to a part of it being transferred to the important commercial crops The problem of food supply is, therefore, becoming acute here every day

The total population of India in 1951 was about 357 million, which in 1961 shot up to 439 million. The population of India is increasing every year by about 1 per cent Every year there are about 50 lakh fresh mouths to be fed The shortage of food must, therefore, increase in cereal output

The following table gives a comparison with U S A. and U K :—

	India	U S. A.	U. K.
Per capita consumption (in calories) per day	1,683	3,088	3,068
Food contents (per cent)—			
Cereals	68.0	23 0	30.0
Pulses	12.0	2 6	1 7

Nutritional elements in daily diet (per cent)

Fats and Oils	4.0	15 0	16.0
Fish	3.0	21.0	27 0
Milk	6.0	13 0	11 0

Deficiency in Indian Food

	Nutritional standard requirements (in ounces)	Quantity now being consumed (in ounces)
Average daily diet of which :—	48.0	18.0
Ghee and oil	2 0	0.3
Milk and Milk products	10 0	5.0
Fish and other proteins	4.0	0.4

The solution of the food problem of India may be found along the following lines:—

(i) Changing the habits of the people, so that more meat and fish may be included in the diet of the people

(ii) Better exploitation of Indian fisheries. The fisheries of India have been neglected so far.

The backward condition of Indian fisheries in due to several factors such as lack of mechanised fishing, poor organisation and management of the fish trade, the conservative nature of the fisherman, inadequate transport facilities and the unhealthy influence of the middleman

(iii) Changing agricultural practices so that more fodder could be grown for cattle or goats which could supply meat or milk Root crops and lucern can be grown in larger quantities as rotational crops, leading to soil fertility and greater supply of cattle fodder. Increased meat and milk supply can then take the place of cereals raised for our food from the soil. In order to bring about this change, however, better facilities for irrigation will have to be provided.

(iv) More manuring of the soil to enable greater yields of crops

(v) Scientific improvement in our agriculture to enable better yields, or reclamation of lands at present lying barren.

(vi) Restriction of the area under certain commercial crops like cotton and jute whose market is mostly outside India and where the competition has become now serious

(vii) Bringing new areas under cultivation by extending irrigation facilities and clearing forests where necessary

Food Problem Short-term Emergency Measures

Short-term measures taken to minimise the dependence of the country on import of foodgrains fall into two categories, namely, measures to increase food production and measures to utilise the foodgrains produced in the country in a judicious manner so as to meet the maximum possible demand with these foodgrains

The measures to increase production of foodgrains were:

(i) Introduction of minor irrigation schemes like construction and repair of wells, tanks, channels, small dams, tubewells, etc

(ii) distribution of chemical fertilizers and other manures amongst the cultivators,

(iii) distribution of improved seeds;

(iv) fisheries development schemes;

(v) land improvement schemes like contour bunding, clearance and reclamation of waste lands, etc ,

(vi) plant protection and anti-plant disease schemes;

(vii) other grow more schemes intended to increase the yield per acre, and

(viii) special campaign now being organised to increase the production of rabi grains, *viz.*, wheat, barley, gram and rabi jowar, by concerted action in educating the farmers in improved method of farming, arranging timely supply of improved seeds, fertilizers manures, etc securing co-operation of village workers and farmers and infusing enthusiasm in them to increase the per acre yield of foodgrains.

For maximum utilization of the foodgrains produced in the country, measures taken were (1) segregating the highly surplus areas where Government could procure foodgrains for distribution in the deficit areas; (2) segregating highly deficit areas and

important consuming centres where Government could concentrate on distribution of foodgrains from Government stocks; and (3) creating more or less self-sufficient zones by joining deficit areas with surplus areas.

Measures were taken for proper and equitable distribution of foodgrains available with the Government in really needy areas through fair price shops so that the available foodgrains could reach the genuine consumers and the supplies available in the country could be shared on an equitable basis by different sections of the population.

INCENTIVE TO FARMERS

As an incentive to higher agricultural production the Government of India have been holding All-India Crop Competitions At present, State Governments are running crop competitions at various levels according to their own rules In order to widen the scope of the competitions as an important measure in stepping up food production and put the scheme. both within the States and at the all-India level, on a more systematic basis, the Government of India have formulated proposals for competitions at (a) village, block, district, and State levels, and (b) on an all-India basis

The all-India competitions are conducted in respect of nine crops, paddy, powar, ragi, maize, wheat, gram, rabi, jowar and potatoes In addition to these, barley is included in the village, block, district and State Schemes

AGRICULTURAL REGIONS OF INDIA

Considering the soil and rainfall distribution, India can be divided roughly into the following agricultural regions:—

1. The Lower Ganges Region.
2. The Upper Ganges Region.
3. The Sutlej Region.
4. The Desert Region.
5. The Black Soil Region.
6. The Crystalline Soil Region.
7. The Coastal Regions.

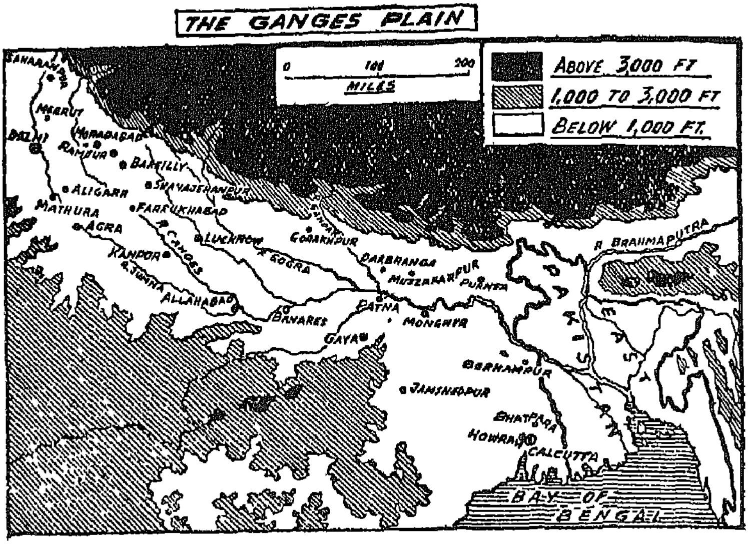


Fig. 26. Showing Ganga Plain

In the case of the first two regions, which include the Indo-Gangetic basin, the basis of division is the amount of rainfall. While in the case of the last four divisions, which are in the Peninsular region, soil determines this division.

1. *The Lower Ganges Region* may be said to include Bengal, Assam and certain parts of Bihar. This region is characterised by an abundance of moisture Over most of the area the rainfall varies between 75 and 100 inches during the year; the larger proportion of it coming during the summer months of June to October. Uniformly warm temperatures are another climatic characteristic of this region.

The region is occupied by the lowest ends of several rivers and naturally, therefore, comprises of low ground River banks and depressions are the two most important physical features of the area.

Composed mostly of the alluvial soils brought down by the rivers, this region has a high agricultural value Except in the lower delta of the Ganga and in some parts of the Burdwan district The proportion of the area under crops to the total area is very high.

The most dominant character of agriculture in this region is that there are only a few crops grown over large areas. The number of crops grown is not large. Rice, jute and tea are the

outstanding crops Oilseeds, sugarcane and cotton are other important crops of this region. The climatic conditions, as well as the large population to be fed, naturally make rice the most widespread crop of the region. Rice dominates the landscape as also the outlook of the people This need for growing rice in this region wherever possible, leaves very little land for commercial crops.

Irrigation plays the least part in the agricultural operations of this region Irrigation canals or wells for irrigation are almost unknown in this region. Whenever there are long breaks in the monsoon rains, some irrigation by lifting water from the numerous depressions, which have almost always some water, is practised.

As manuring is not common in rice cultivation, and as rice is the most widespread crop, the use of manures (except in tea plantations) is not important in this region. The annual floods, in fact, supply such large quantities of new, fertile silt every year to the fields that the soil naturally recoups its fertility without any manure In tea plantations, however, the use of manures is common

Owing to the large agricultural population in relation to the area fit for cultivation, the fields are generally very small in the region. These fields are cultivated with the help of bullocks, the use of agricultural machinery being almost unknown here Most agricultural operations are done by hand labour, which is a characteristic feature of all rice lands. The stagnant water in the depressions and in the rice-fields breeds malaria which saps the health of the agricultural labourers and agricultural labour is, therefore, not very efficient here During the last war to protect the soldier much was done to eradicate malaria by providing drainage canals and spraying of insecticides

Weeds are very common in the fields here A very serious problem facing agriculture in some parts of this region, specially Bengal, is the spread of the **Water Hyacinth** This weed takes root in the stagnant water and is difficult to eradicate It completely chokes any crop growing in such water, and thus makes large areas, formerly good agricultural land, unfit for crop cultivation The Government is spending a good deal of money in research work to free the land from this curse. The reeds are also a menace to cropland.

The lack of good fodder supply is the cause of the dearth of good and healthy animals in this region. Rice which is the most widespread crop here, does not yield a suitable or nourishing fodder for animals. The other important crops grown here do not yield any fodder at all.

Besides, the climate and soil here do not favour grasslands. The depressions are almost always covered with water, and so grass cannot grow there The uplands or river banks are valuable farming land and cannot be left over for grass. The areas unfit for agriculture are also unfit for grass. For example, the lower delta is subjected to saline tide water which does not permit the growth of suitable grass for fodder. The crystalline soils belonging to the peninsular class are too porous for the growth of grass

Dairying or meat production are, therefore, not important in the agriculture of the region.

2. *The Upper Ganges Region* is by far the richest agricultural region in India. It comprises parts of Bihar and Uttar Pradesh Ordinarily, the rainfall in this region is neither too much nor too little for agricultural purposes The seasonal character of the rainfall distribution, however, makes irrigation an integral part of the agriculture of this region There is a clearly marked rhythm in the winter and summer temperatures. The winters are cool, while the summers are hot Based on these temperature differences, the crops grown in the region fall into two distinct classes The rabi crops are suited to winter conditions, while the kharif crops are suited to summer conditions

As seen above, irrigation plays an important part in the agriculture here. This irrigation is, however, confined entirely to winter crops which are grown when the season is characteristically dry Wells predominate in the irrigation of this area. Nowhere else in India are there better geographical conditions for well irrigation than in this region The high water-table, the occurrence of claybeds in the sub-soil, the predominance of saturated sand, the filtering of water from the more rainy areas of the Himalayan foot hill—all these provide the most favourable geographical conditions for well irrigation

Even though well irrigation is the most characteristic form of irrigation in this region, canal irrigation is not far behind. The most important canals of the region, the Ganga Canal, the Jamuna Canal, the Agra Canal and the Sarda Canal irrigate considerable areas of land

An important feature of the agriculture of this region is the multiplicity of crops grown here There is hardly any other part of India where the variety of crops grown is so great as it is in this part This multiplicity of crops depends, of course, on the absence of extremes in agricultural conditions. There are moderately varying conditions of rain-fall, temperature and

soils which enable a large number of crops with varying requirements to be grown in this region.

Considerable use of manures is another important feature of the agriculture of this region The importance of wheat and sugarcane, which need considerable nutrition from the soil in order to yield well, makes the use of manures incumbent The manure used consists largely of the animal refuse and domestic refuse. The large number of animals found in this region is, thus, a great help in providing animal manure The fact that a large amount of cow-dung is used as a domestic fuel in a region where the demands on soil fertility are so great is a great agricultural drawback Cow-dung is a valuable manure Its use for any other purpose, therefore, deprives the soil of a source of fertility.

The most important crops of the region are wheat, rice and sugarcane There are distinct areas in which these crops predominate; as for example, wheat dominates the western section, rice the eastern section and sugarcane the middle section of the region. These crops occupy generally the best land The interior soils are given over to the cultivation of poorer crops, like barley and millets, etc.

The occurrence of large areas of pastures, especially in the low-lands near the numerous rivers, enables a large number of cattle and other animals to be kept Most of the cattle are meant for agricultural operations Dairying is, however, being encouraged in the neighbourhood of large towns

Due to the vagaries of rainfall, large parts of this region suffer now and then from famines The 'famine zone' is marked particularly in the areas that adjoin the Peninsular region The famines cause the greatest damage to the poorer food crops, and hence the greatest suffering to the poor For the more valuable crops are generally grown in areas which are well supplied with irrigation facilities Rice suffers most during famines, as it requires the greatest amount of moisture and is grown in areas where obviously, canal and well irrigation are least developed

Fields in this region are very small The agriculturists are generally very poor, due to the great pressure of population on land The presence of the industrial town of Kanpur, and the towns manufacturing sugar, makes it possible for the agriculturists of this region to supplement their income from agriculture by working in these towns during the slack season when the agricultural operations do not need them

The presence of large towns has offered an incentive for growing fruits and vegetables in this region on a fairly large-scale. Large quantities of potatoes and cauliflowers are grown in the area around big cities and urban areas These vegetables find ready profitable markets even in distant places like Calcutta and Delhi

3 *The Sutlej Region* comprises the Punjab and Himachal Pradesh. The Sutlej river and its tributaries play the most important part in the agricultural development of this region. Except in a small strip lying near the foot-hills of the Himalayas, where the rainfall is enough, the whole agriculture of this region depends upon irrigation. Irrigation is, therefore, the outstanding fact of this region.

The contrast between winter and summer temperatures is marked here more than in the Upper Ganga Region The winter crops, like wheat, therefore, flourish here better than in other parts of India The winter rainfall in this region is enough for the growth of these crops

The soils of this region are mostly alluvial silt which approach desert conditions wherever the rainfall is deficient The hot and comparatively dry climate of the areas causes considerable evaporation of water In some cases this evaporation draws to the surface salts from the sub-soil. These salts lie as a crust over the soil and destroy its agricultural usefulness.

Wheat, cotton and sugarcane are among the most important crops of the region. The cultivation of fruits on the foot hills of the Himalayas is a characteristic feature of the agriculture of this region. Canal irrigation is the most important feature of this region in the plains

The proximity of the Sind and Rajasthan desert, which is the chief breeding ground of the locust in India, makes this region specially liable to attack by locusts which may cause, therefore, very serious damage to crops in this region Large sums of money are being spent every year by the Government to eradicate the locust-menace to this region

In the area near the Himalayas where the rainfall is adequate, the variety of crops grown is considerable But in areas where canal irrigation is the chief source of agriculture, the crops grown are few in number.

The fields in this region are generally large and the cultivators here are better off than in any other part of India. The dry climate of the region makes them sturdy and so they labour

on their fields harder than any other cultivators in India. The riches of the Punjabi cultivator are, therefore, the proper reward of his efficient and hard work on the fields

The pastures in this region are poor due to dry climate. There is consequently a dearth of fodder for cattle and other animals in the region The cultivators, however, have enough land and there is not much pressure of population on land This enables them to devote some portion of their land, specially to growing fodder crops The most important fodder crop grown in this region is lucern There is no other part of India which has as great an acreage under lucern as this region. Fed on such a nutritive fodder as lucern, the cattle in this region are strong and healthy Some of the Punjab breeds of cattle like the Hissar or Hariana breeds are famous all over India

4 *The Desert Region of India* includes certain parts of Rajasthan The desert is not a wholly barren area where nothing would grow. On the contrary, wherever water is available for irrigation, agriculture is carried on This agricultural land naturally occurs in river valley where well irrigation helps certain crops to grow

Agricultural areas in the Desert Region occur in isolated localities. They are extensive. Whenever such areas occur, cattle population is found. The most important crops grown in this region are those that require the least amount of moisture and yet can endure the great heat of the region during summer. Small millet (bajra) and moth is such a crop and is, therefore. grown extensively in this region wherever cultivation is possible. In favourable localities wheat is cultivated during winter

In hilly areas in this region a few animals, especially goats, are reared on the poor pastures

The region provides the chief market for the surplus of agricultural produce in the neighbouring regions, as it does not produce enough itself The cultivators in this region are poor though hardy As its name implies, this region is the poorest of all agricultural regions of India

5 *The Black Soil Region* covers a large area in the Peninsular region This region coincides with the **regur** or the Black Cotton Soil of India It extends over parts of Maharashtra Madhya Pradesh, Mysore and Madras State. As the region extends over a large area, there are considerable local differences of climate and soil. Generally speaking, the region gets about 30 to 40 inches (75 cms to 100 cms) of rainfall The temperatures are moderately high throughout the year

Agriculture over large areas of this region is carried on by rainfall without much irrigation. The character of the rivers in this region is such that they cannot be used to any great extent for irrigation except in a few localities as in Gujarat. These rivers generally flow in gorge-like valleys far below the general level of the country Lifting of water is, therefore, difficult for irrigating the fields. These rivers, unlike the rivers of the north, do not have their sources in mountain snows. Their water supply, therefore, is dependent entirely upon rainfall. They are mostly dry in the dry season. For well irrigation also the conditions are not generally favourable It is only here and there that wells can be bored with any hope of getting water These wells often dry up after giving water for some years It is only in areas where the Black Cotton Soil is very deep that well irrigation becomes important. Thus, irrigation is not an important feature of this region

The most important crop of this region is cotton It is, however, not grown everywhere in this area Only those places where the soil is deep enough to supply enough nutrition and is retentive of moisture specialise in cotton cultivation Elsewhere, poor food crops like jowar and bajra (millets) are the important crops. Due, however, to local differences, a great many other crops are also grown in the region. Among these minor crops, mention must be made of wheat, the cultivation of which is fairly important in the Malwa Plateau and in the valley of the Narbada. Sugarcane is another such crop which is grown in isolated favourable localities

The Black Soil Region is varied by the occurrence of hilly areas here and there. The neighbourhoods of these hills generally provide extensive though poor pasture lands On these pastures numerous cattle and goats are reared Such pastures also occur in the neighbourhood of rivers whose banks are often a maze of ravines

The fields are generally large in this region, but the soil is not equally fertile everywhere. Irrigation facilities are also not abundant The yield from these fields is not, therefore, high The cultivators are, therefore, generally poor in this region

6 *The Crystalline Soil Region* also extends over a large section of the Peninsula It occupies part of Maharashtra, Madras, Madhya Pradesh, Orissa and Andhra Pradesh

The region is covered by red and yellow soils, and in some places also by latrite, which are characteristic of areas composed of very old rocks This part is geologically the oldest in India The soils derived from these old rocks are generally

infertile. This region, therefore, is markedly a region of poor soils. Continuous agricultural tracts as one comes across in the Gangetic Valley are, therefore, rare in this region The topography of this region is broken or undulating There are isolated blocks of hills belonging to the Satpuras and the Eastern Ghats There are also the plateaus of Chhota Nagpur, Mysore and Andhra This fact further reduces the area of agricultural land here Valuable agricultural lands, however, occur in the depressions and in the river valleys wherever they widen out In such areas there are deep deposits of finer soils which are well suited to the growing of valuable crops like sugarcane and rice. On elevations and slopes the soil is generally coarse and not very deep. In such areas only poorer crops can be grown.

The temperatures are high throughout the year and the differences between winter and summer temperatures is very little The rainfall is copious, varying from 30 to 50 inches (75 cms to 125 cms) per year Over most of the area rainfall comes both during summer and winter, but rain falls below the normal in this region more than anywhere else in India This brings the famine conditions which are so frequent here The ravages of the famines are very serious particularly as the land is comparatively poor in fertility and the cultivators are not able to store large reserves of food Even a slight departure from the normal rainfall causes distress, especially as the moisture requirements of crops in this region of high temperatures are great. These requirements can seldom be satisfied from other sources as the facilities of irrigation are not abundant Famine must, therefore, be regarded as a chronic problem in this region

Millets, particularly bajra, are the most widespread, because they are suited to the climatic conditions and the poor soils of this region as no other crop. Other important crops are groundnuts, cotton, rice and sugarcane. The absence of wheat cultivation to any extent, due to the poor soils and hot climate, is a marked feature In especially favourable areas on the slopes of the mountain plantations are an important feature in this region Tea, coffee, rubber and spices are produced in these plantations and tank irrigation is important

The broken character of the land and infertile soils generally give rise to extensive pastures These are, however, poor and can support only goats in large numbers Cattle are not so important on these pastures as goats

The fields are rather large, but the general infertility of the soils does not enable the cultivator here to get big yields from these fields The cultivators in this region are generally poor. They are not very healthy and strong as the climate of the

region causes various maladies. Hook-worm disease is very widespread in this region. This disease gradually saps the vitality of the people and makes them weak.

7. *The Coastal Region* is the smallest in extent It includes the coastal plains lying on the eastern and western coasts of India The plains on the east are wider than those on the west These coastal plains comprise mostly of the river deltas which are larger on the eastern than on the western coast These plains are usually hot and moist The soils are fertile throughout except in the neighbourhood of the sea where sand lowers fertility The fertility of the soil has been increased now by the provision of canal irrigation in the larger deltas.

Rice is the most dominant crop though sugarcane, tobacco, and cotton are also grown wherever conditions favour

The fields are generally small, but the rich soil enables the cultivators to raise large crops from their fields. The cultivators are not as poor as those in other agricultural regions comprised within the Peninsula

QUESTIONS

1 Bring out clearly the geographical reasons given for saying that it is possible to increase the agricultural output of India.

2 Discuss the distribution of rice in India

3 Describe the physical and economic conditions associated with the production of sugar in India noting recent developments.

4. Compare and contrast the agricultural conditions in the Punjab and Bengal, with special reference to natural and artificial water supply.

5 Describe in relation to soils and climate the distribution of the principal crops of Peninsular India

6 What are the chief oilseeds produced in India? Where and whence are they exported?

7 Give an account of the production of oilseeds in India Illustrate your answer by a sketch map Which of the oilseeds are exported and to which countries? In each case mention at least one port of export Describe the uses to which oilseeds are put in European countries

8 Draw a map of India mark thereon the principal areas of the production of —Rice, Wheat, Cotton, Wool, Silk, Jute, Tea, Tobacco, Linseed and Groundnuts.

9 Under what geographical conditions is wheat grown in India? How far do these conditions differ from those in the leading wheat-producing countries of the world?

10. What is the importance of cotton cultivation to the Indian cultivator? What are the main tracts growing cotton in India? How far the geographical conditions differ in them?

11 Why is the cultivation of the following crops almost confined to certain localities —

Jute, Jowar, Sugarcane and Tea?

12 What is the position of oilseeds in Indian agriculture? Point out the geographical conditions under which the main oilseeds of India are grown

13 Why is India so important agriculturally? Discuss

14 Why is the Dairy industry not so important in India as in Europe or America?

15 What are the essential conditions of the cultivation of fruits and vegetables? How far are these conditions fulfilled in India?

16. Divide India into agricultural regions, and describe the agricultural conditions of any one of them.

Chapter 6
Irrigation

The importance of agriculture to the people of India compels them to protect the soil against damage and to get as much from it as possible. Irrigation is one of the methods whereby Indian agriculture is assured of stability. There are two features in Indian rainfall which make irrigation necessary. These are: (a) Uncertainty of rainfall distribution, both in time and place, and (b) irregularity in distribution through the year, i e. the concentration of practically the whole of the rain in a few months, leaving the rest of the year dry Temperatures in India being suitable for the growth of crops throughout the year this shortage and uncertainty of moisture supply is a great hindrance and is partly removed by irrigation.

India occupies the most important place in irrigation in the whole world Roughly, about one-third of the total irrigated area of the world lies in India. Some of the largest canal systems of the world are found here. All this is because nature has endowed India with certain advantages that are seldom to be met with in other parts of the world on such a large scale.

In spite of it, India is not able to satisfy her entire demand for irrigation. It is only a small fraction of her total cultivated area that gets irrigation. Only about one-fifth of the total cultivated area in India is being irrigated Of the 37 28 crore acres of the total cultivated area in India in 1958-59 about 5 78 crore acres received irrigation, which although is only 16% of the total cultivated area, yet has registered an increase of 63 lakh acres over the total irrigated area in 1950-51.

The poverty of the people and lack of irrigational facilities over certain parts in India are obviously the reasons for this small proportion of irrigated area. Most of the irrigated area in India (about 60%) lies in the Indo-Gangetic Valley where the facilities for irrigation are the greatest. Owing to the fertility of the soil and the cultivation of certain important crops like sugarcane here, it pays to irrigate in this valley.

Irrigation is needed in India —

(i) for the whole country to grow Winter or 'Rabi' crops during the long dry season, characteristic of monsoon climates;

(ii) for those arid regions in which the normal rainfall is too meagre to allow agriculture without being regularly supplemented by artificial irrigation; the entire agriculture of such regions depends on irrigation, as in some parts of Rajasthan and the Punjab,

(iii) for those areas in which the rainfall is insufficient and uncertain.

It is only in certain areas like Bengal, Assam, and the Submontane Tarai regions, where the moisture supply is always abundant that irrigation is not needed

GEOGRAPHICAL ADVANTAGES

The geographical advantages for irrigation in India are.—

(a) the perennial rivers of the north, with the sources in the perpetual snows of the Himalayas;

(b) the gradual slope of the plains, so that the canals taken out from the upper courses of the rivers easily irrigate the land in their lower valley,

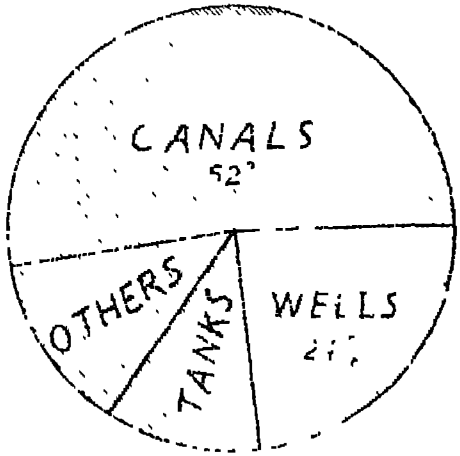


Fig. 27 Percentage of irrigation

(c) the absence of rocky ground in the plains facilitates easy cutting of canals

(d) the fertile soil which gives the greatest returns to irrigation; and

(e) clay-beds, deep in the sub-soil, which act as reservoirs for the rain water which sinks through the porous alluvium of the plains and which is later tapped by wells.

Irrigation in India, 1956-57

(In Lakh Acres)

States	Canals	Tanks	Wells	Other Sources	Total
Andhra Pradesh	31.48	29	7.9	2	70.68
Assam	8.9	—	—	6.3	15 33
West Bengal	15.1	9 6	.4	4 9	30 09
Bihar	15.1	5.9	5 2	17.4	43.84
Maharashtra & Gujrat	6.8	5.2	22 9	1 0	36 16
Jammu & Kashmir	7.0	—	—	24	7.43
Kerala	4 1	.7	.29	3.0	8 29
M. P.	9.6	2 7	7.2	.8	20.49
Madras	19.9	21.9	12 3	89	55.17
Mysore	4 0	8.0	3.2	2 9	18.29
Orissa	5.5	12.3	.94	5.4	24.14
Punjab	49.5	.1	24.65	29	74 59
Rajasthan	6.9	4.6	22.38	.9	34 90
U. P.	42 79	10 40	54 12	6.8	114.20
Total India	229 1	110.9	162 2	54 4	556 8

During 8 years ending 1958-59 the net area irrigated increased by 63 lakh acres as shown below ·

Area under Irrigation (in lakh acres)

Source	1950-51	1958-59	Increase or Decrease
Canals . .	205	239	+34
Tanks .. .	89	218	+29
Wells .	148	165	+17
Other Sources ..	73	56	-17
Total . .	515	578	+63

The most important sources of irrigation in India are:—

(i) Canals;

(ii) Wells, and

(iii) Tanks.

The canals are the most important sources of irrigation because of their cheapness and the ease and certainty of supply. Out of about 58 million acres, the total area irrigated in India, about 24 million acres are irrigated by canals (Government and private, both).

CANAL IRRIGATION

The canals in India are of two classes:—

(a) Inundation canals, and

(b) Perennial canals.

Inundation canals are taken out from rivers without building any kind of weir at their head to regulate the flow of the river and the canal. Whenever the river is in flood, water passes into these canals. As soon as the flood subsides and the river falls below the level of the canal heads these canals dry up. The greatest defect of these canals is that their water supply is very uncertain They provide irrigation mostly during the rainy season when alone the rivers are mostly in flood. During the dry period when irrigation is needed most, these canals are useless The larger number of inundation canals is in the Punjab. They have been taken out mostly from the Sutlej river, which has high floods during the rains. Owing to the uncertainty of water supply, most of the inundation canals are being converted into perennial canals with the help of the development of the large irrigation schemes

The real importance of irrigation in India is that of the Perennial canals, about 50,000 miles including the mileage of the distribution This length is so great that it can completely encircle the earth at the Equator twice. Such stupendous irrigation works have never been known in the history of the world before And yet, they are not enough for the needs of our agriculture.

The Perennial canals irrigate only about one-tenth of the total cultivated area of India. The largest mileage as well as the largest acreage irrigated is in U P. where about one-third of the total cultivated area is irrigated by canals

(i) IN THE PUNJAB

There is no part of India which is so favourably situated as regards its rivers, or so unfavourably as regards its rainfall as the Punjab

By far the greater portion of it has less than 25 inches of rainfall per year Even this amount is often liable to failure Until the introduction of irrigation, therefore, a large area was a waste The only exception were the river banks where agriculture was possible to some extent by means of inundation canals and wells.

The problem of irrigation in the Punjab was different from that in other provinces of India. In all other irrigation schemes the main object had been the improvement of the existing agriculture In the Punjab, some tracts had to be colonised, simultaneously with the introduction of irrigation

The Triple Canals system in the Punjab is one of the largest in India Its main object is the irrigation of a tract of the Punjab lying between the Ravi and the Sutlej rivers, bounded on the south by the dry bed of the Beas, known as the lower Bari Doab This system transfers the waters from the Jhelum, where they were much greater than could be utilised in the watershed between the Jhelum and the Chenab, for irrigating the water-shed between the Chenab and the Ravi and the Lower Bari Doab

The transfer was effected by constructing a regulator at Mangla on the Jhelum. From Mangla the Upper Jhelum Canal carries the Jhelum into the Chenab, discharging it into the latter above the head-works of the Lower Chenab Canal at Khanki. The Lower Chenab Canal is thus fed with the Jhelum water, and the water of the Chenab so freed is taken from a new headwork situated at Merala, 36 miles above Khanki, into the Upper

Chenab Canal. This canal runs south-wards to the Ravi, which is crossed on the level at Balloki. Below Balloki it is known as the Lower Bari Doab Canal.

The three rivers, Jhelum, Chenab and Ravi are thus inter-connected by means of the Upper Jhelum Canal and Upper Chenab Canal

The chief reason for this scheme of canals was to conserve the Sutlej water for the further development and extension of irrigation on either side of the river. The Sutlej Valley Scheme was, thus, the direct outcome of the great Triple Canal system. The Triple Canals Scheme has brought a further huge extent of wasteland under cultivation.

There are, on either bank of the Sutlej, long series of inundation canals, which draw their supplies from the river, whenever the river level was high.

The object of the Sutlej Valley Scheme is threefold:—

1 By providing weirs and head regulators, to afford to the existing inundation canals a controlled supply of water from the beginning of April to the middle of October, thus freeing them from seasonal fluctuations. These canals are now converted from inundation to non-perennial canals i e. the supply is assured during summer as well, though they are closed during winter, when the volume in the river is low.

2 To extend irrigation to all the low-lying areas in the Sutlej Valley.

3 To give year-round irrigation to large tracts in the uplands on either side of the river.

A special feature of the canal system of the Punjab lies in the fact that all the rivers of the Punjab have been interconnected by means of canals so that the water resources of all the rivers are pooled together to give the greatest service. All available supplies of water in the rivers are utilised to the full

The scheme consisted of four weirs, three on the Sutlej and one on the Panjnad (the name given to the Chenab below its junction with the Sutlej now in Pakistan) with twelve canals taking off from above them The scheme really consisted of four inter-connected canal systems

The largest canal system of the Punjab is the Sutlej Valley Canal system which accounts for about one-fourth of the canal-irrigated area of the Punjab, including Pakistan. Weirs have

been constructed at four places on the river Sutlej and eleven canals have thus been taken out on both sides of the river. These dams are at Firozpur, Sulemanki, Islam and Panjnad. The most important crops irrigated in the Punjab are wheat and cotton These two crops account for about half the total irrigated area. Rice comes next in importance.

The canals that are wholly in the Punjab (India) are the Bari Doab canals, the Sutlej Valley canals on the left bank of the Sutlej, and the Sirhind canals starting from Rupar.

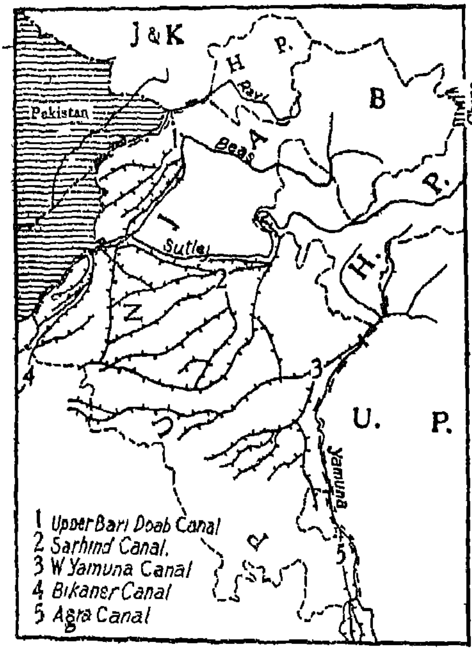


Fig 28. Canals in the State of Punjab

The West Jamuna canal was completed in 1820. It takes its water from Jamuna at Tajewala and irrigates 10,18,000 acres of land through its 1900 mile long channels in the districts of Rohtak, Hissar, Patiala and Jind.

Sirhind canal was completed in 1884 It takes water from the Sutlej river at Rupar It irrigates 2,312,000 acres of land in the districts of Nabha, Ferozpur, Hissar and Ludhiana

The Upper Bari Doab canal was completed in 1879 and takes water from Ravi at Madhopur It irrigates 73,000 acres of land in the districts of Gurdaspur and Amritsar

(ii) IN U P

The primary importance of the canals in U P is that they are essentially meant for periods of drought. Unlike the Punjab where, over large parts, no cultivation is possible without canals, in U P , in normal years, there is enough of rainfall and there are plenty of wells, so that it does not require canal irrigation Canals when once built must be used, because irrigation from them is cheap and convenient. The largest canal system in U P is that of the two canals from the Ganga, though, if taken singly, the Ganga canals yield the place of honour to the newly constructed Sarda canal. The Upper Ganga canal, as well as the Sarda canal have been taken out at a point where the rivers come down from the mountains Owing to the heavy rainfall a large number of rivers rise in the **Terai** and join the Ganga in its m dle course It becomes possible, therefore, to take out a Lower Canal to irrigate the middle section of the valley Such a thing is not possible in the Punjab where the rainfall is less and the **Terai** is absent, leading to the absence of tributaries in the middle course of the rivers The volume in the Punjab rivers dwindles as they flow away from the mountains, while in the case of U P rivers it increases because the rivers flow through a wet country This enables a 'lower canal' to be taken out. The Lower Ganga canal already exists, while Lower Sarda Canal has recently been constructed as people become used to canal irrigation. There are two canals from the Jamuna also. Few minor canals also exist in south U P. like the Ken, Ghaghra and the Betwa canals and in the east namely Dohri Ghat Canal.

Canal irrigation is no less important than well irrigation in U P. The area irrigated by canals here is about 5 million acres This is only about one-tenth of the total area sown, and only one-third of the total area irrigated. The canal-irrigated area in U P , however, fluctuates from year to year according to the condition of rainfall In the years when the rainfall is scanty, canal-irrigated area is very large The wheat, barley, sugarcane and cotton are the important irrigated crops

Like the Punjab, a serious problem has arisen in the canal-irrigated areas of U P and that is the problem of alkaline soils which are believed to be due to over-irrigation, so natural in a country where scarcity of water leads to famine

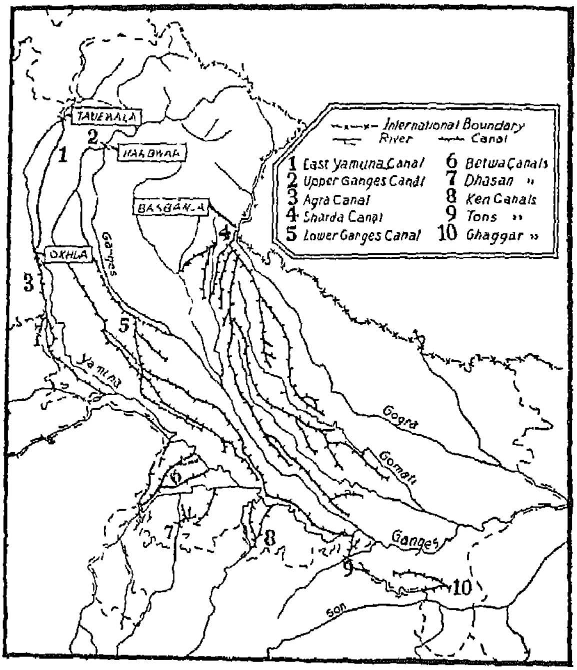


Fig 29. Canals in the State of U. P

The high rainfall makes it necessary to construct and maintain drainage works in this State to safeguard the canals from damage. The drainage works in this State have a longer mileage than the canals themselves

An important service rendered by the canals in U P is that they help in reducing the intensity of floods in the Ganga and the Jamuna, by opening up all their branches and distributories in flood time

The Upper Ganga Canal was completed in 1854 It takes off from the Ganga at Hardwar and passes through a broken country, passing over or under bridges Its main branches are Deoband branch, Anupshahr branch, Mat branch and Hathras branch. The Upper Ganga Canal is the oldest canal built by English engineers As the slope of the ground was not properly surveyed at the time of the cutting of the canal, the flow of the water was defective To remove this defect artificial waterfalls were made in this canal at several places The main canal joins the Ganga river at Kanpur, but one of its branches continues beyond Kanpur and ultimately joins the Jamuna above

Allahabad. The main canal is 213 miles (242 kms) long with branches and distributories totalling 3,400 miles (5474 kms) It irrigates 16,200,000 acres of land.

The Lower Ganga Canal was completed in 1880 It takes off at Narora in Bulandshahr district. This canal crosses the Upper Ganga and one of its branches near Kasganj and then leaves it to flow into the Jamuna near Fatehpur The total length including channels exceeds 3,000 miles (4830 kms) and irrigates 1,251,000 acres of land

The Eastern Jamuna Canal is taken out from the Jamuna near Faizabad (in Saharanpur) where the river enters the plains. The canal re-enters the Jamuna near Delhi.

The Agra Canal was completed in 1875. It is taken out from the Jamuna at Okhla (near Delhi) and irrigates nearly 350,000 acres in the area west of the Jamuna It then joins River Jamuna near Agra.

The Sarda Canal is the longest Canal in U P It was completed in 1930. It is taken off from the Sarda river near Baramdeo near Nainital One of its branches feeds the Rohilkhand Canal. The other branches irrigate the area of the Ganga-Ghagra Doab. It irrigates nearly 1,300,000 acres of land.

Betwa, Dhasan and Ken rivers in Bundelkhand area of U.P. supply waters to small canals

(iii) IN MADRAS

The Madras State is another area where canal irrigation is important Here most of the canals are in the deltas on the east coast where suitable land for canal irrigation lies These deltas are not wet like the Ganga delta where tremendous discharge of the Ganga and the Brahmaputra rivers keeps the soil too wet to need irrigation The greater rainfall of the Ganga delta keeps the depression filled to serve the needs of irrigation, if there is occasion for it at all.

In Madras also the canals are more important as a source of irrigation than either tanks or wells The canals irrigate about one-third of the total irrigated area here The crops that are important under irrigation are rice, jowar, bajra and cotton.

Most of the rainfall on the east coast comes during November and December when the important summer crops have been reaped To help these summer crops to grow during the period when the rainfall is low, canal irrigation is absolutely necessary At this period the tanks and wells become less effective

owing to smaller rainfall The canals, on the other hand, drawing their water from rivers which have their sources in regions which have most of their rainfall during summer, are able to supply the much-needed water for crops

The Delta canals of the east coast are used to a considerable extent for navigation as well The deltas are not well provided with railway This naturally adds to the importance of canals as means of transport in the region

The canal irrigation in other parts in India is not much important, either because the canals are small, as in Maharashtra or they are meant for some other purpose and irrigation is only a secondary object, as in Bengal and Bihar The Bengal canals are primarily for supplying clean drinking water and for draining the low-lying parts, as well as for navigation.

The canals of the area adjoining the Western Ghats are characterised by high dams across deep mountain valleys Thus the valleys are converted into reservoirs from which canals are taken out An important example of such a dam is the Bhandardara Dam in Maharashtra It is one of the highest dams in the world In the district of Ahmednagar, at Bhandardara on the Pravara river, a dam 270 feet (82 35 metres) high has been built to collect the high rainfall of the Western Ghats The canals taken out from here are about 85 miles (136 kms) long

Another example, needing much engineering skill, is that of the Periyar river whose course has been diverted from the west to the east to utilise its waters for irrigation The valley has been closed towards the west by means of a dam 171 feet high and a lake has thus been formed The waters of this lake are let into a canal 150 miles long through a tunnel 1¾ mile long through the mountains The main feature of the Periyar system is the diversion of the Periyar river from the Arabian sea into the Bay of Bengal This river has its source in the Palani Hills in Kerala whence it flowed westward into the Arabian Sea through a forested and an uninhabited country To the east of the watershed is the Madurai district of Madras which was subjected to frequent famines The Vaigai river is the only drainage of importance in Madurai and on its scanty and unreliable water supply practically the whole irrigation of this district depends

The principal thing in the scheme is the dam This is situated in a V-shaped gorge in the Hills A lake is thus formed From the most northerly arm of this lake the water is led for about a mile through a deep open cutting to the mouth of a tunnel made across the watershed On the other side of the

watershed a short open cut conveys the water into a natural ravine, by which it finds its way into the Vaigai. It is through the Vaigai river, therefore, that the waters of the Periyar are utilised for irrigation.

Irrigation facilities have resulted from some of the works built specially for generating hydro-electricity. Among such works the Mettur Dam in Madras State is of outstanding importance

The Mettur Dam is built across the Cauvery river at a point 240 miles from its source. The Dam has been built with a double purpose (i) to generate hydro-electricity and (ii) to irrigate about a million acres of rice fields in the Cauvery delta, 125 miles away from the dam Irrigation is done with the help of about 70 miles of main canals together with about 600 miles of distributories

Some of the important canals and the area irrigated by them are given below:—

Canal	Main Mileage	Distributory Mileage	Area Irrigated Lakh acres
Upper Ganga .	569 (910 4 Kms)	3429 (5486 4 Kms)	17.2
Lower Ganga	640 (102 4 Kms)	3321 (5313 6 ,,)	13
Eastern Jumuna	129 (206 4 Kms)	836 (1337 6 ,,)	4
Agra Canal ..	100 (160 Kms)	911 (1457.6 ,,)	4
Sarda Canal .		5500 (8800 ,,)	15 7
Cauvery Delta Canals	943 (1508.8 Kms)	3798 (6076 8 Kms)	10
Godavari Delta Canals	510 (816 ,,)	1925 (3080 ,,)	11 1
Krishna Delta Canals	425 (680 ,,)	2374 (3798 4 ,,)	10 9
Periyar Canals	152 (243 ,,)	118 (188 8 ,,)	1 4

WELL IRRIGATION

The well may be said to be the indigenous form of irrigation in India It is very well suited to the poor Indian farmer, because it is cheap to build, requires no elaborate machinery to work it, and does not need any specialised engineering skill to build it or to work it It can be dug at the very door of the farmer, if necessary Well digging needs no elaborate survey of levels as is necessary for canal construction A simple "kachcha" well costs very little in most of the districts, and is, therefore, within the means of the poorest of farmers. A canal, on the other hand, costs lakhs of rupees and can be undertaken, in a poor country like India, only by the Government

Apart from this economic consideration, well irrigation is suited to a large part of India on geographical consideration also Over a large part of the country the soil consists of a sandy loam underlain here and there by isolated beds of clay which appear floating in a sea of sand that is highly saturated with moisture that percolates through the soil These clay beds act as reservoirs which when tapped by digging, supply large quantities of water which can easily be lifted to the surface The geological formation of India is too simple to provide opportunities for 'artisan wells' where the pressure of water underneath is so great that it comes to the surface automatically. In some localities where the above mentioned clay beds are thick enough, much larger supplies become available in the well by boring a hole (tube-well) through the clay than are possible in the ordinary 'spring well' These 'tube-wellls' are expensive to build, and, to be effective, need machine power to lift large quantities of water

The factors governing the supply of water to the underground which feeds the wells are .—

1. Local rainfall,

2 Slow seepage from the land lying at the base of the mountains or Terai, where the rainfall is higher;

3 Seepage from canals and canal-irrigated lands and seepage from other water bodies

Well irrigation in India is limited by :—

(a) Water level being too low in certain areas. This is particularly found in the neighbourhood of rivers It appears that water level sinks deep near the river banks to rise in the river bed No generalisations are possible with regard to the water table in India as the subject has not yet been studied. Those districts in which the rainfall is very heavy usually have a high water table and water is very near the surface In other districts, where the rainfall is limited water table is low and the wells have to be very deep

(b) The second limitation is the brackishness of the well water Brackish water is useless for irrigation as it destroys the crop. No data are available in this respect also, but it appears that brackish water may appear anywhere, even in a locality where other wells are sweet. The districts where water is usually brackish have very little well irrigation

(c) The third limitation is that a large number of ordinary wells dry up during periods of drought when their water is needed most They also mostly dry up after a few hours' excessive lifting of water and are, therefore, unable to irrigate large area.

An analysis of the figures of well irrigation shows that the well irrigation is of considerable importance in

(i) that part of the Gangetic Valley which is in close proximity of the north eastern and eastern extension of the Deccan tableland This includes the eastern extension of the Deccan tableland This includes the eastern part of U P, Southern Bihar, and Western Bengal.

(ii) Regions of the Black Cotton Soil, specially where it is deep.

(iii) The submontane area on the eastern side of the Western Ghats

This includes southern districts of Maharashtra, Gujarat and of Madras especially Coimbatore, Madurai and Ramnad, etc

(iv) The Sub-Montane districts of the Punjab

The regions immediately in the neighbourhood of the Himalayas, the Assam and Arakan Hills, and to the west of Western Ghats are particularly deficient in well irrigation.

Well irrigation accounts for about 30 per cent of the total irrigated area in India The most important States in order of importance are U P, Bombay, the Punjab, Rajasthan and Madras. Even in canal-commanded areas well irrigation is practised in elevated parts where the canal water cannot reach.

TUBE-WELLS

The U.P Government bored a number of tubewells to extend irrigation in areas where canal water could not reach These tubewells are worked by electricity The drawing of large quantities of water from the tubewells raised the question whether the water table of the province will be lowered and thereby dry up a number of the ordinary spring wells. The question has been enquired into by Mr Auden whose report is summarised below[1] —

The areas in which tubewell pumping is contained should not be considered as isolated units independent of the neighbouring areas, they should be regarded as part of the Gangetic alluvial system, which, cast of the submerged extension of the Aravallis from Delhi towards Dehra Dun, occurs in a single basin almost certainly without underground barriers of any

magnitude. Continuity of the alluvium in this basin permits the greater rainfall supply of the Terai belt being operative as a means of replenishment in the area to the south. The boring of the tubewells has proved that sand predominates over clay in the sub-soil of this basin. The water in these sands occurs as a continuous reservoir, which must be connected with the strata below the Terai where the rainfall is greater. There is, therefore, a considerable excess of rainfall over the water removed by pumping

These tube-wells are usually 300 ft deep in the districts of Azamgarh, Ballia, Ghazipur, Jaunpur and Varanasi, where the strata consist monstly of clay and they may have to be sunk as deep as 500 ft. Special boring machines have been ordered for the purpose from abroad.

The average discharge of a well may be taken as 30,000 gallons per hour and with this supply five acres will be irrigated in 24 hours with a field water depth of four inches. Water of one tubewell usually commands an area of about 1,000 acres, irrigating about 400 acres annually, *i.e.* 150 acres of sugarcane and kharif and 250 acres of rabi To irrigate and 'mature' this area, the well should run 3,200 hours annually,

For successful tubewell irrigation are needed (i) the area must be in alluvial formations where water bearing strata at various depths are found, (ii) cheap power for lifting water must be available, (iii) the soil should be of good quality so that high costs involved in the operation of tubewells are compensated by large produce

For carrying the tube-well water to various parts a network of channels, called "Guls," is constructed and each tubewell has one mile of brick-lined and two miles of unlined Guls.

As regards distribution of water for irrigation, when demand is not full, cultivators get water as soon as they ask the tubewell operator for it When the demand is full every one wants to be served first and for such periods of keen demand, a system of distribution of water, called the 'Osrabandi', is drawn up for each well, under which turn as well as time of each group of cultivators is fixed and water is distributed by the operator, accordingly

The Government of India have entered into another agreement with the U S Government, under the T C A programme,

1 From the report to the U P Government on Tube-wells

for the construction of 350 exploratory tubewells in 16 States to obtain geological and hydrological data required for a sound development of ground-water resources.

The districts of Bahraich, Gonda, Basti, Gorakhpur and Deoria on the north of the river Ghagra and Faizabad, Sultanpur, Azamgarh, Ghazipur, Ballia, Jaunpur and Banaras on the South, have very little irrigation works They depend almost entirely on rainfall and whatever irrigation is done from open wells, tanks, 'jhils' or 'tals' and rivers.

The comparatively high rainfall of these districts, when well distributed and timely, is more than adequate for the requirements of the crops in general and it was mainly for this reason that irrigation schemes, when prepared, were not taken up for execution in the past

GANGA-GHAGHRA DOAB

When the Sarda Canal scheme was taken up, a provision was made to irrigate also the whole of the Ganga Ghaghra Doab, down to Banaras and Ballia, but the waters of the Sarda were subsequently found insufficient for all this area and, consequently, the eastern districts lying in this Doab were left out In 1937 the Ghaghra canal was constructed in the district of Faizabad by pumping water from the Ghaghra but the scheme did not prove remunerative with the irrigation rates without the surcharge

As it was not found feasible to construct gravity canals for these eastern areas, various projects for pumped canals, proposing to utilise the waters of the Ghaghra, the Ganga and the Rapti, were prepared from time to time but they were not taken up particularly because the spring levels in the area being comparatively high, it was feared that the introduction of canal irrigation might result in further raising the subsoil water table, thus affecting the productivity of the soil adversely as well as the health of the people Most of these districts are also liable to floods in varying degrees and this again indicated that canals were, in general, not suitable for sucn areas.

The Government, therefore, decided to construct tube wells and in the First Five-Year plan construction of 2,000 tube-wells were completed in the following districts:—

Bahraich, Gonda, Basti, Gorakhpur, Deoria, Faizabad, Sultanpur, Azamgarh, Jaunpur, Ghazipur, Ballia, Varanasi Etah, Mainpuri and Farrukhabad

12

The work was completed on the Sarda Canal reservoir in the catchment area of the Chauka river designed to maintain an annual supply of 8,276 million cubic feet of water.

Nearly 1,50,000 acres of land is being irrigated in the eastern districts ensuring additional production of foodgrains amounting to 10 lakh maunds.

This was part of the larger plan to extend the Sarda Canal and its channels in the districts of Rae Bareli, Pratapgarh, Sultanpur and Jaunpur and raise their capacity to ensure the flow of a larger volume of water

In the Deccan, water-bearing strata are seldom found except in faults and fissures in the rock The exact location of an underground stream is necessary for any successful boring. This is where the help of a geologist is required and a water divider may also help Twenty-one tube wells with an aggregate discharge of about 400,000 gallons per hour have been made for the Ahmedabad mills.

Sub-artisan tube wells are those in which water requires pumping Sub-artisian water is generally obtainable between 250 feet below surface, while for artisian flow, the boring requires to be carried down to between 600 to 1,000 feet below the surface.

A fine example of an artisian bore may be seen at Chhaloda near Ahmedabad Here a boring was put down 842 feet deep and yields a water supply of 650,000 gallons per day. This water comes up the tube under great pressure and has been flowing day and night for the last several years The travellers from Ahmedabad pass through miles of dry sandy soil and on approaching Chhaloda appear to have come upon an oasis in the desert. The water has formed lakes round the village The actual cost of the water comes only to 1 pie per 1,000 gallons.

TANK IRRIGATION

About 18% of the total irrigated area of India is accounted for by the tanks, a little less than half of it being in the states of Madras and Andhra. The only areas important for tank irrigation outside the Deccan tableland are in North Bihar and Southern U.P The undulating topography of the Peninsular region, and the depression provided by the old beds of rivers in North Bihar are converted into tanks by deposits of rain water. Like

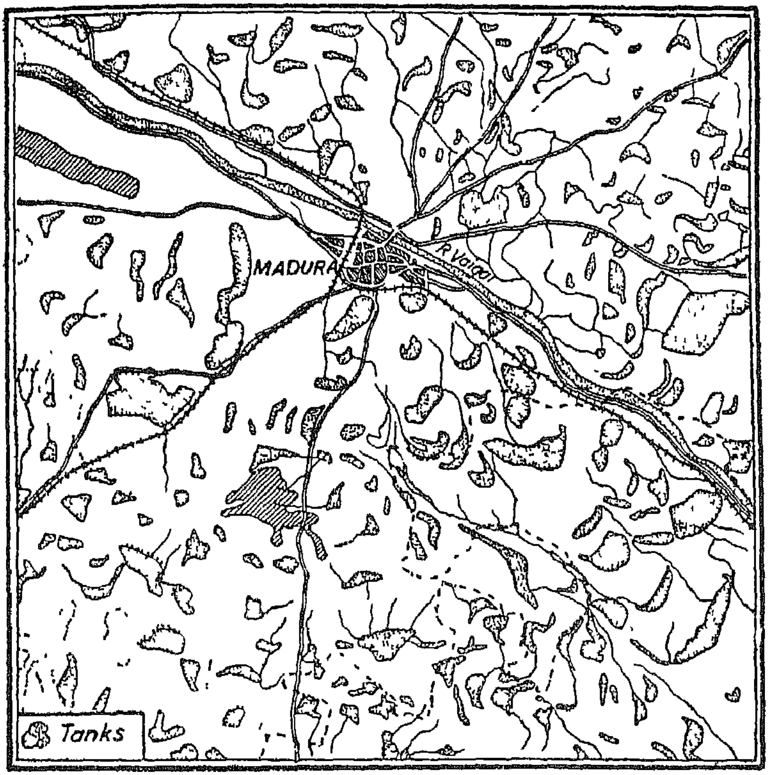


Fig 30 Irrigational Tanks around Madura in Southern India

the well irrigation, the tank irrigation also suffers from uncertainty of rainfall over most of the areas where tanks are common

EXTENSION OF IRRIGATION

The importance of irrigation is not the same for all crops grown in India The crops which have to be in the field during the dry period of the year are naturally the most irrigated crops in India But owing to the considerable labour and expenses involved in irrigation, only the most paying crops are irrigated first. Thus, sugarcane, cotton and wheat are generally the most important for irrigation Cotton is, however, less irrigated than sugarcane, chiefly because it is grown mostly in the Black Cotton Soil This soil is difficult to irrigate owing to cracks in it and owing to fewer facilities for irrigation being present in that area Important areas of irrigated cotton occur generally in the Punjab and in Madras

If irrigation facilities were available, about two-third of the area under wheat could benefit This would increase the yield and, therefore, the total output of wheat in India.

The progress of irrigation in India is not rapid Irrigated areas cover only 17% of the total sown area in the country. There is a great scope for irrigation in West Bengal, Bihar, Orissa, U P and Bombay

The growing need for extending irrigation facilities in India is further shown by the following table which gives the proportion of the total cultivated area that receives irrigation in certain areas:—

Proportion of Irrigated to Cultivated Area

State	%Irrigated to cultivated	State	%Irrigated to cultivated
Assam ..	23	West Bengal ..	19
Bihar ..	16 5	Kerala	20
Bombay ..	6	Andhra	29
Punjab .	41	M P. ..	5
Madras ..	40	Mysore .	7
Orissa ..	14	Rajasthan ..	21
U P. ..	27	J. & K. ..	38

It is clear, therefore, that extension of irrigation facilities is the primary need of Indian agriculture

Of the net area under cultivation about 16% is under irrigation. During the period from 1950-51 to 1958-59 the net area under irrigation rose to 63 lakh acres as under:

Area under Irrigation (in lakh tons)

Methods of Irrigation	1950—58	1958—59	Progress
Canals ..	205	239	+34
Tanks	89	118	+29
Wells	148	165	+17
Other Sources ..	73	56	—17
Total	515	578	+63

DEVELOPMENT UNDER THE THIRD PLAN

It is proposed to bring 1.28 crore acres of cultivable land under irrigation during the 3rd Plan as against 90 lakh acres during the 2nd Plan The total expenditure on the project is estimated at Rs 250 crores To meet this heavy expenditure it has been suggested to invest all the savings under agricultural production sector to this scheme, besides, giving financial aid wherever necessary Instructions have been issued to the authorities concerned for maintenance and protection of existing canals, headwork and feeding channels. Further new surveys and planning are also being encouraged to keep up the spirit of the plan and to bring new areas under irrigation

QUESTIONS

1 Why is irrigation so necessary for Indian Agriculture?

2 How far do geographical factors help the practice of irrigation in India?

3 Why are canals more popular sources of irrigation than wells or tanks in India?

4 Briefly describe the important canal system of (a) Punjab and (b) U. P emphasising the nature of the country they serve

5. What factors, geographical and economic, favour well irrigation in India?

6 Will the power-worked tube-wells in U. P affect adversely the water table?

7 Why is it more difficult to dig wells in the Deccan than in the Ganga Valley?

8 Write a short note on —

(a) Mettur Dam

(b) Bhandardara Dam

(c) Irrigation in the Punjab

Chapter 7
Industrial Fuels

Coal is the outstanding industrial fuel of the modern world. Without it the present 'Machine Age' will come down crashing In the modern world the economic power of countries is measured by the amount of coal they have It is around coal that most of the industries of the world rotate Nature has, however, not been very generous to India in the matter of coal Most of the coal of the world is found in the Cool Temperate Zone of the Northern Hemisphere and not in the Tropics of which India is a part

COAL

Coal mining was started here in 1774 in Raniganj by John Summer and Suetonis Grant Heatley. The ventures failed, and the next serious attempt was made 40 years later However, not much work was done until 1843 when the Bengal coal company was formed The opening of the E I Ry in 1855 and its extension to Barakar Coal areas in 1865 gave a fresh impetus to coal mining as the Railways provided transport and created demand for it.

Production of coal showed rapid increase after 1868, as shown below:—

Year	Production Lakh tons	Year	Production Lakh tons
1868	5	1940	251
1880	10	1946	260
1890	22	1950	320
1900	61	1955	382
1910	120	1956	394
1920	180	1957	435
1930	238	1958	452

It has 1.1% of the total reserves of the world's coal At the end of the year 1959 India had 840 collieries with Bihar as the foremost state having a total number of 529 Next was West Bengal with 214 collieries. It is estimated that nearly 35,000 persons are engaged in coal production (Daily average)

According to available but authoritative sources the production of coal reached 5,611 lakh tons in 1961 which further shot up to 6,153 lakh tons in 1962, thus having an additional output of 542 lakh tons over the previous year.

Today India stands eighth among the coal producers of the world. Her total production amounts to 46.07 million tons which was about 1/8th of U S A.'s, 1|7th of the U S S.R and 1|5th of the British coal-production for that year. This will be clear from the figures given below:—

Coal Production (000 metric tons)

Country	1938	1956	1958
U S A	357 9	472	389,355
U S S R			352,990
Great Britain	30 6	221500	219,287
Western Germany	151 3	132215	133,582
Poland	.		94,981
France	46 5	54293	57,721
Japan		.	49,674
India	28 7	39000	46,066

The coal-fields of India can be broadly divided as follows —

1 Gondwana coal-fields:

(a) Damodar Valley fields (i) Jharia, (ii) Raniganj, (iii) Bokaro, (iv) Giridih, (v) Karanpura (North and South).

(b) Mahanadi Valley fields. No importance.

(c) Sone Valley fields No importance.

(d) Godavari Valley fields: (1) Singareni.

2 Tertiary coal-fields

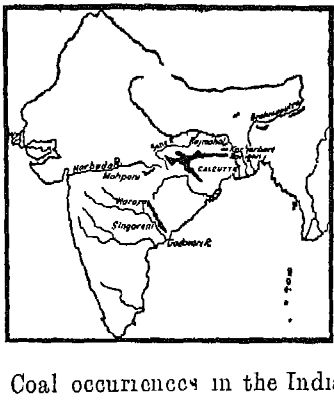


Fig 31. Coal occurrences in the Indian Union

(a) Makum in Assam, (b) Palna in W. Rajasthan.

Practically 97 per cent of the coal supplies of India are derived from the Gondwana rocks which are found in the Deccan tableland These rocks are very old and are composed chiefly of sandstones and shales which appear to have been entirely deposited in fresh water and probably by rivers The only section of the Gondwana system which is important from the point of view of coal production is that known as the Damuda series from its development in the valley of the river Damodar. In the Raniganj and Jharia fields these rocks can be sub-divided into three stages or divisions, of which the top and bottom divisions, known respectively as 'Raniganj' and 'Barakar' rocks, alone contain coal seams The rocks lying between these two divisions are 'ironstone' shales which possess no coal The most important coal seams in the Raniganj coal-fields are found in the Raniganj 'rocks' while the most important seams in Jharia

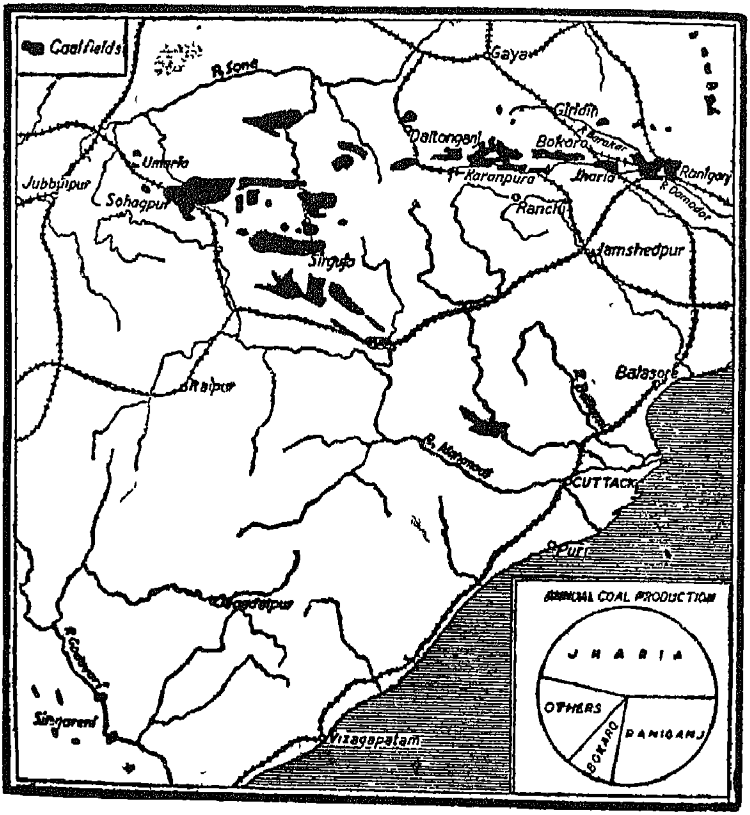


Fig. 32. The main coal-fields of India.

coal-fields occur in 'Barakar rocks'; that is, good coal occurs in upper rocks in Raniganj coal-fields, and in lower rocks in Jharia.

The fields which have been worked out to some extent in the Gondwana region include —

(1) The Raniganj and Jharia fields in the Damodar Valley;

(2) the Giridih field occurring as a small isolated patch to the north of the Damodar Valley,

(3) the Daltonganj field, further west in the Palamau district,

(4) the Singareni, Ballarpur and Warora fields in Godavari Valley, and

(5) the Mohpani and Pench Valley fields adjoining the Satpuras.

The north-west ends of the Godavari and Mahanadi valley coal-fields have been buried under the great sheets of Deccan trap, and therefore, no one knows how much coal lies hidden under this cover Similarly the eastern ends of the Jharia and Raniganj fields are buried under the Ganges alluvium making it impossible to determine the quantity of coal in India

Outside the Peninsula and the Gondwana rocks some coal occurs in Assam This coal is newer in age than the Gondwana coal It is known as the 'Tertiary' coal The thick seams of the Lakhimpur district in the Dihing River Valley in Assam are the most important in tertiary coal in India

The following table shows the production of coal and its target in India for 1960-61·—

Coal Production in Million Tons

State	1954	Output in 1960-61	Increase
Assam ..	0 50	0.50	—
West Bengal—			
Darjeeling .	0.03	0.03	—
Raniganj ..	12.22	18.16	5.94
Bihar—			
Jharia	13 19	16.69	3 50
Karanpura .	1.44	6 00	4.56
Bokaro .. .	2.38	2 88	0.50
Giridih	0 26	0 26	..
Other fields ..	0.14	0.14	—

Madhya Pradesh—			
Chindwara and Canda	2.25	2 25	—
Korba .. .	—	4.00	4.00
Sasti .. .	0 07	0 07	—
Central India Coal-fields	2.31	5 31	3 00
Orissa . .	0.52	0 52	—
Andhra (Singareni)	1 43	2 93	1.50
Rajasthan .	0.03	0.03	—
	36 77	50·77	23 0

The Jharia coal-field is the most important Indian coal-field, not only because it produces about one-half of the total coal produced in India, but because it produces the best Indian coal It is the only coal-field in India which has sufficient quantities of cooking coal Its area is only about 150 sq miles (387 sq kms) The 'Barakars', or the lower lays of the Gondwana rocks, are by far the most important of the coal mines No attempts were made to work the thinner and poorer seams of the upper layers, the Raniganj, until the boom in the coal prices in 1906-08 led to the opening up of every tolerable seam of coal within range of the railways There are 18 seams in the lower (Barakar) rocks totalling about 200 feet (61 metres) of coal, numbered from the outer fringe running like a crescent. The Raniganj mines are deepest in India and seams occur up to a depth of more than 2,000 ft (610 metres) Except in the south-east corner of these seams, which is considerably faulted, there is little disturbance in the coal seams By far the larger proportion of hard coke made in India is made from Jharia coal, and the recovery of coke averages about 75% of the coal used

The coals of Raniganj, Jharia and Giridih coal-fields compare in quality as follows.—

Coal from the Best Seams

Coal-field Seam	Moisture	Volatile matter	Fixed carbon	Ash
	%	%	%	%
Raniganj, Ghusik .	7 5	34 8	52 6	12 6
Raniganj, Dishergarh ..	2 5	33 2	54 2	9 8
Jharia, No 18 .	1 8	28 8	59 3	11 9
Jharia, Nos 5-6 .	0 6	14 1	66 2	19 8
Giridih, Karharbari	0.9	22 5	66 0	10 6

A large quantity of the coal in Jharia field, as also in Raniganj and Bokaro field, has been burnt out by the Deccan lava.

The damage caused is particularly great in the 14th and 15th seams The evidence of this burning is to be found in the large quantity of *'Jhanwan'*.

The Raniganj field produces about one-third of the total coal of India It covers an area of about 500 sq miles (1290 sq Kms) most of it being in the district of Burdwan, but stretching also across the boundaries into Bankura, Manbhum and the Santhal Parganas. It occupies a larger area than the Jharia coal-field The seams dip generally to the south and south-east throughout the field As the beds dipping to the south-east are covered by the alluvium of the Damodar Valley, the distance to which the coal-bearing rocks extend in this direction towards Burdwan and Calcutta is unknown. There are six workable seams in the upper (Raniganj) rocks totalling roughly 50 feet (15 25 metres) of coal The 'Dishergarh' seam of Raniganj has the most valuable steam coal in India which is in great demand for railways and ships

The importance of the Jharia coal-field lies not only in the fact that it contains the best coal in India, but also in the fact that it lies on the margin to the Gangetic plain with a network of railways, and that it lies near Jamshedpur, Kulti, Asansol, and Calcutta which are the largest markets for coal in India Jharia is connected by E Rly with Calcutta which is about 170 miles (270 kms) from it It is connected with Jamshedpur, The E. Rly thus supplies its coal to the Indo-Gangetic plains and also carries it to the Indian peninsula It covers an area of 175 sq. miles (450 sq kilometres)

In spite of the good quality of coal in Jharia, no manufacturing industries of any importance have been attracted to it. The chief reason of this is the fact that there are no valuable raw materials near it The immediate neighbourhood of Jharia consists of almost barren and rocky land where it is difficult to obtain large quantities of suitable water Even the coal mining industry gets it's water with difficulty Unlike the best coal-fields of Europe or America, Jharia is, therefore, unable to attract any industry to itself

Besides the above two coal fields of great importance, India has a few coal-fields of minor importance. The great belt of Gondwana rocks, near the north-west end of which Warora is situated, stretches down the Godawari Valley as far as Rajahmundry, and at one or two places the equivalents of the coal-bearing Damuda series of Bengal are found cropping up from below the upper Gondwana rocks. One of these occurrences, near Yellandu in Andhra forms the coal-field named Singareni. The principal seam of coal is about 5 to 6 feet thick which is a dull, hard and non-coking, steam coal largely consumed by railways and mills in Southern India.

TERTIARY COAL-FIELDS

The newer or Tertiary coals of Assam differ from the Gondwana coals in containing a large portion of moisture and volatile matter They also generally have a lower ash content. The Tertiary coals have a high sulphur content which makes them useless for coking

The most important among the Tertiary coals are the Assam coals near Makum The collieries are connected by a metre gauge railway with Dibrugarh on the Brahmaputra river, which being navigable forms both a market (used on steam boats) and a means of transport for coal The coal-bearing rocks

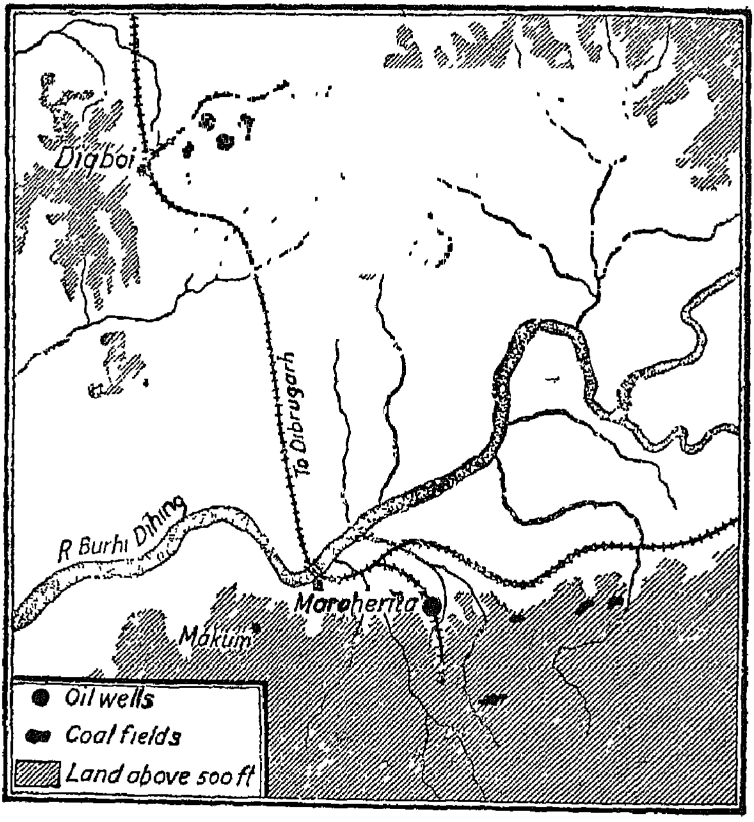


Fig 33 Occurrence of coal and oil in Assam.

stretch over long distances both to the north-east and the south-west The most valuable seams occur between the Tirap and

the Namdang streams where, for a distance of about five miles, the seams vary from 15 to 75 feet (4 to 23 metres) in thickness. Near Margherita, the average thickness of the thickest seam now being worked is about 50 feet (15 25 metres) In the Namdang section it increases to as much as 80 feet (24 metres). The outcrops in many places are several hundred feet above the plains on mountain slopes, and facilities exist for working the coal by adit levels as in Wales Coal can be dug in horizontal tunnels, not in deep vertical pits

Coal of good quality also occurs in the Namchick Valley, a tributary on the left bank of the Dihing River, above Margherita.

New coal-fields have been discovered in Rewa, M P. (Pathakera and Koba) and Bihar (Hutar). The Garo hills in Assam Jammu and (Kalakot) have been surveyed to contain large deposits of high grade coal Large lignite deposits have been discovered in South Arcot districts (at Neyveli) covering an area of 16 sq. miles (41 28 sq kms) with 32 feet (9 7 metres) in thickness. This is said to be the longest find in India The development programme for these deposits envisages the mining of 35 lakh tons per year of lignite which is to be used for (i) generation of power (2 5 lakh KW), (ii) production of carbonised briquettes (3 8 lakh tons); and (iii) production of fixed nitrogen (70,000 tons)

New coal deposits have also been discovered in the Daup area of Nepal Tarai (the western districts of Khajawali and Sohratgarh) The coal is said to be of high grade Digging operations have been started with the help of the U P Government.

A reserve of 0 5 million tons of second and third grade coal in the Kota-Singrauli area in Mirzapur district, has been found by the Geological Survey of India, which has also recommended deep drilling for further proving of reserves

In the above geological formations, quite close to Kota, extensive deposits of coal have been located by the Geological Survey of India at Navanagar (in Madhya Pradesh) The drilling is still going on

In M P new coal-field has been located in the Khobra area The field is stated to cover about 200 sq miles divided into two sections each containing about 6 million tons of first grade coal per square mile

A coal-bearing region, extending over an area of 13 sq. miles (36 kms) has been located in Bankura district of West Bengal A new deposit has been located near Ondal, where Narsamuda and Upper Kajora bottom seams are inferior in quality but Upper Kajora top, lower Kajora, Bonbahal and

Topsikenda carry grade 1 coal The reserve is estimated to be of the order of 5.26 million tons with a much larger quantity of probable reserves.

The discovery of lignite deposits in Kashmir has, it appears, opened up possibilities of industrial development for the State. The Kashmir Directorate of Industries has prepared a Rs 7-crore scheme for the exploitation and utilisation of these lignite deposits discovered in the State The scheme, to be completed in two stages, envisages, in the first phase, mining operations to produce 1,500 tons of lignite a day and installation of a thermal power plant with a capacity of 10,000 kilowatt In the second stage, the plant will undertake manufacture of gas and fertilisers. Part of the gas will be used in the production of ammonia and the remainder will be supplied for fuel purposes to domestic consumers The lignite deposits in the State, as discovered in 1923-24 were estimated at 128 million tons In 1955-56 the Geological Survey of India surveyed Nichenama and Shaliganga *via* Barmulia and Sopore along a tract, 50 miles long and 10 miles wide (80 kms to 16 kms) The survey covered four sectors and the reserves were estimated to be about 86 million tons.

COAL RESERVES

It is estimated that the total reserves of all kinds of coal in India amount to about 54,000 million tons Of this only about 5 p c is supposed to be suitable for coking[1] The three most important fields in respect of coal reserves are Raniganj (21,000 million tons), Jharia (20,000 tons) and north Karanpura (8,000 million tons)[2]

1 The 'coke' is made from coal by first powdering it and then burning it, until the impurities in coal are removed This burnt coal is then cooled by pouring water over it Lumps then form We, thus, have the coke The capacity to form into lumps is the chief feature of 'coking coals' Good quality coals produce 'hard coke' while the inferior quality coals produce 'soft coke' The former alone can be used in the metal industries

2 The National Planning Committee Report (Power and Steel), 1947 estimated the Reserves of India as follows —

Total Coal Reserves of India

Darjeeling and Eastern Himalaya	100
Giridih-Deoghar	250
Ranigunj-Jharia	25,650
Sone Valley	10,000
Chhatisgarh and Mahanadi	5,000
Satpura Region	1,000
Wardha Valley	18,000
Total	60,000

Of these reserves good quality coal is only 5,000 million tons of which Raniganj accounted for 1,800 million tons and Jharia 1,250 million tons

The Coal Mining Committee (1937) estimated the quantity of good quality coal at 4889 million tons, while Dr. Gee in 1944 placed this figure at 4,520 million tons In 1946, Mr A B. Dutt estimated that there were 4,460 million tons of good quality Gondwana coal in seams not less than 4 feet thick and within 2,000 ft (610 metres) from the surface He estimated the resources of tertiary coal as 2,527 tons

Dr Fox and Dr Fermor of the Geological Survey of India estimated for the whole country the total quantity of coking coal suitable for the manufacture of metallurgical coke at the end of 1932 to be as follows.—

At depths of 0—1,000 feet (305 meters)=1,118 million tons
At depths of 1,000—2,000 feet (305 to 510 m)=576 million tons

Total—1,605 million tons

No doubt, in the opinion of Dr Fermor, small additional quantities of good coking coal will be discovered in the future, possibly for example, in west Bokaro, but the probable amounts are not likely to alter the real position. In addition, with technical research coking coals, not at present regarded as coking coals, such as the semi-coking coals of Karanpura may also become available But these are, after all, only possibilities

Apart from Giridih, which is only a small field, the best coking coals in India occur in the Bhagaband and Jialgara stages of the Jharia field, 737 million tons of this is in depths up to 1,000 feet (305 metres) from surface and 163 million tons between 1,000 and 2,000 feet (305 to 610 metres) With the present methods of working not more than 50 p c of this coal will be won, and the remainder will be lost due to collapses, fires and floods The total annual extraction from Jharia is about 10¼ million tons, practically all of which comes from the Bhagaband and Jialgara stages in which all the coking coal is concentrated. The life of the coking coal of the Jharia field, down to 1,000 feet (305 metres) from the surface is taken by Dr Fermor to be 41 years under the present circumstances He expects this life to be reduced to 33 years under normal development of mining in India[1] If the methods of mining are improved and sand packing is undertaken to check fires and subsidence, this life may be increased to 100 years

Three big discoveries of metallurgical coal have been made at Bokaro and Raniganj, by the Geological Survey of India. These discoveries are expected to make India self-sufficient in grade one coal for decades to come The quantitative and accurate qualitative estimates have yet to be made and the work has been handed over to the Indian Bureau of Mines

The Metallurgical Coal Conservation Committee has estimated the reserves of coking coal at 329 6 million tons in respect of selected grade, 395 7 million tons of grade I quality and 49 1 million tons of grade II quality. With stowing, washing and blending the Committee thought that a reserve of 2000 million tons of good quality coking coal could be obtained The Geological Survey of India estimated the reserves of Gondwana coal and Tertiary coal at 38,116 and 4,533 million tons respectively

The first attempt to determine the reserve qualitatively with some precision was made in 1950 by the Metallurgical Coal Conservation Committee, which estimated the reserves of coking coal as follows —

Grades	Quantity (In million tons)
Selected A and B	1,300
Grade I ..	659
Grade II	553

The Working Party of the Coal Industry made an estimate in 1951 of the non-coking coal in the country and stated that the total quantity of non-coking coal, including tertiary coal was of the order of 39,650 25 million tons. The party, however, was not sure of the total reserves of good quality non-coking coal.

Coal Conservation

It is clear from the above that there is a great need for conservation of Indian coal This need is to be doubly emphasised in view of the post-war and post-Independence schemes of industrial development in India. The best method of conserving Indian coal is to reserve the use of the best quality coals only for metallurgical industry These coals should not be used for generating steam as in transport or industries For steam purposes, for example, inferior coals from Raniganj or other coal-fields should alone be used The most inferior coals should be used either in the form of liquid fuels or they should be used for generating electricity which can then be used for industrial purposes.

Conservation also implies a better system of mining Miners should take out all coal that can be practicable. The present practice of taking out only the best quality coals and leaving the rest in the mines in such a way that it can never be recovered must be given up It is obvious that this can be done only when it is realised that coal is a national asset on which the future of India depends, and that it is an asset which can

never be reproduced. Once lost, it is lost for ever This characteristic and the importance of coal make it necessary that the exploitation of Indian coal should not be left entirely in the hands of the private capitalist

Conservation of Indian coal also implies that every ounce of energy that can be obtained from it must be obtained, or every bit of by-product that it can yield must be recovered from it in the interest of the future of the country. The present wasteful method of softcoke making must, therefore, be changed Dr Chatterji,[1] for example, calculates the loss involved in the production of Soft Coke in India (about 2 million tons yearly) as follows.—

2 million tons of Soft Coke result in the loss of·—

0 75	million	gallons of	motor	spirit
1 5	"	"	"	light oils
3 0	"	"	"	lubricating oils
0 75	"	"	"	Carbolic acid and Creosote oil

10,500 tons of ammonia sulphate
12,000 tons of residual pitch
7 5 billion cubic feet of rich gas from which 50 million horse power can be developed.

The First Plan made a number of specific recommendations regarding coal —

(i) Adoption of measures for conservation of metallurgical coal, restriction of output and enforcement of washing and blending and of stowing for conservation;

(ii) Detailed mapping of important coal-fields and assesment of reserves of material suitable for stowing;

(iii) Evolving a scientific classification for coal based on calorific value ash and moisture contents and coking property,

(iv) Stepping up of production from outlying field;

(v) Research for washing, blending and carbonization of coal;

(vi) Legislation for the enforcement of stowing for conservation, washing and blending, consolidation of cesses;

(vii) Extension of use of Soft Coke for domestic purposes with a view to conserving cow-dung for manurial purposes.

1. N N Chatterji, *Proceedings of Indian Science Congress*, 1945

Since the First Plan was set into implementation the following actions have been taken on the above recommendations:—

(1) With the passing of the Coal Mines (Conservation and Safety) Act, 1952, a positive step was taken for the conservation of metallurgical coal

(2) Resurvey of Raniganj, Jharia and Bokaro Coal-fields has indicated substantially larger reserves of coal in these fields Karanpura coal-field has revealed the existence of many new coal seams while Jhilimilli coal-field is expected to contain coking coal.

(3) In the interest of conservation and having regard to the need to supply coal of fairly uniform quality to the steel industry, the Coal Washeries Committee recommended the following measures:—

(a) All metallurgical coal down to grade II should be washed;

(b) the average cost of washing should be made good to the collieries through either revision of prices or a negotiated price for washed coal;

(c) washeries may be set up.

THE SECOND PLAN

As against a target of 60 million tons, production during 1960-61 has been 54 26 tons. Though the actual production had fallen short of the target yet the annual rate of production commensurate with the targets set for them. The production of coal increased from 32.31 million tons in 1950 to 38.23 million tons in 1955 and reached 54 62 million tons in 1960-61

Coal Mines Act 1952 (Conservation and Safety) was enacted to enforce conservation measures Stowing was extended to cover conservation. Measures were adopted to regularise the production of coking coal with a view to conserve the limited reserves Washing being one of the measures for conservation the Second Plan provided for additional washing capacity of 6 4 million tons to be achieved by the establishment of 4 central washeries and the installation of a washing plant at Durgapur steel plant. A capacity of 2 4 million tons has already been set up and the rest was done in the first year of the Third Plan

Other conservation methods include a phased programme for the substitution of coking coal consumed by essential consumers by non-coking coal and provision for the grant of a

special subsidy to mines handicapped by adverse factors, namely, gassiness, depth of working etc Besides, steps are also being taken for the amalgamation of small and uneconomic collieries as recommended by the Committee on Amalgamation of Small Collieries

INDUSTRIAL FUELS

The use of machinery in the coal industry is at a preliminary stage of development In 1957, on an average, there were 458 coal cutting machines in about 155 mines which produced 23% of the total output. Also, there were 5 mechanical loaders and about 92 mechanical conveyors in operation.

The Progress of Coal Production in Five Year Plans

The Second Five Year Plan target of coal production in India was 60 million tons a year, out of which the shares of the public and private sectors were to be 15 million tons and 45 million tons respectively. The following table will show how far both the sectors have carried out their assignments :—

Year	Private Sector	N. C D. C	Singareni	Total
1959	40 33	4.48	2 22	47 03
1960	43 34	5 95	2·48	51.77

(Production in million tons)

During the 12 months ending 28th Feb. 1961, the coal out put of the Private Sector amounted to 44 5 million tons—a mere half million tons below its target. By the end of March, 1961, it reached its target It is learnt that the National Coal Development Corporation has exceeded the Second Plan target rate of production During the last quarter of the last year of the Second Plan period (January-March 1961) the rate of production of coal was 13 7 million tons a year as against the target of 13.5 million tons Singareni had already exceeded its target rate at the end of 1960 Thus the total of 60 million tons at the end of the II Plan has been achieved by all means.

The target of coal production in the III Plan, as endorsed by Coal Council in November 1960 has been fixed at 97 million tons (98 5 million tonnes) per annum by the end of 1965-66, representing an additional production of 37 million tons, out of which the shares of Public and Private Sectors would be 20 million tons and 17 million tons respectively. But with the progress in the Plan additional responsibility may be laid on either sector.

COAL TRADE

India has a very limited home market for coal Ceylon, Burma, Pakistan and the Far Eastern countries are the only important markets outside India Our export trade in coal is, therefore, insignificant

In 1957 we exported coal to the tune of 1,625,000 metric tons (worth Rs 49,678,000), and in 1958 our exports of coal amounted to 1,741,000 metric tons (worth Rs 53,329,000) The exports of coke from India amounted to 72,783 metric tons and 80,047 metric tons in 1957 and 1958 respectively

The high cost of land transport which our coal must bear, if it is to be exported, and the general industrial backwardness of our neighbouring countries, which limits the demand for our coal, are some of the factors in our backward foreign trade in coal.

The largest market for our coal is the home market This market is, however, negligible. India is a hot country where the demand for domestic-heating, common in Europe or America, is not important The backward industrial development of India is also a factor in this smallness of the market for coal in India. The result is that the per head consumption of coal in India in normal years is not even one-thirtieth of that even in such a country as Canada The following table gives the per head consumption of coal before the war :—

Great Britain	3.9 tons
Belgium	3 9 „
U.S A.	3.3 „
Canada	2.2 „
Germany	2 0 „
India	0 07 „

About 40% of the coal produced is consumed by manufacturing industries and about 32% by railways. The backward state of our industries limits the production of our coal, because more coal will be produced if there is a demand for it. A profitable source of the demand is the domestic use of soft coke for coaking purposes It has been noted that practically nine-tenth of our coal is inferior in quality from which only soft coke can be manufactured This soft coke can be used best in our homes as domestic fuel, releasing the cow-dung which is a valuable manure rather than fuel We have also seen that the wood fuel is limited in supplies in India. It will,

therefore, be best for the coal trade which can then give more employment for our railways which will get more business; and for our agriculture which can get more cow-dung for manure, if we used more and more soft coke as fuel in the home

Owing to the efforts of the Indian Soft Coke Committee about 9 lakh tons of soft-coke were supplied to the market in 1939 from the Bengal and Bihar coal-fields. This amount rose to 13 lakh tons in 1952 In the opinion of this Committee if the railways charge lower rates on soft coke it can easily compete with wood and charcoal in cheapness. The use of soft coke increased from 1 1 million tons in 1950 to about 1 6 million tons in 1955-56

The inferior quality coal is not suited to the manufacture of by-products It is only from the coal from which hard coke, suitable for smelting, is manufactured that some by-products are obtained at present These by-products are coal-tar and ammonium sulphate. The former has a large market in Calcutta and the latter is mostly exported to Java.

Unlike the coal in U S A. and Europe, Indian coal occurs in regions which are not endowed with facilities of water transport which is the cheapest method of transporting coal. There are no canals or navigable rivers in the chief coal-producing region of India The scarcity of even drinking water is a feature of these regions which is a source of great inconvenience to the people working in the mines

Both in Raniganj and in Jharia underground fires are causing a great damage to the coal and are a cause of serious colliery accidents, apart from reducing our resources in coal. At present, according to mining experts, the coal town of Jharia is seriously threatened with extinction in the near future by these underground fires which attack it from three sides—Pure Jharia, Khas Jharia and Suratar collieries The Kuresea mine of the National Coal Development Corporation in Madhya Pradesh which employs 5,000 workers, and whose monthly output is about 50,000 tons of high volatile quality coal, has also been closed due to underground fires The mine is now being sealed which is expected to cost about Rs 1 lakh The colliery is estimated to have a reserve of 50 million tons of coal. Sand-stowing or filling the affected part of the mine with sand, is the best method recommended for putting out these fires. Owing to the expense involved, however, our mine-owners are seldom willing to follow the practice They generally seal the portion of the mine which is affected by underground fire and stop work in that section.

The approximate quantity of coal consumed by the principal consumers in India during 1958 was as follows —(in million tons)

Railways	14 861	Paper mills	0 635
Iron and Steel plants	4 251	Jute mills	0 393
Eelectric Supply Cos.	4	Brick burning works	1.792
Cement factories	2 2	Chemical factories	1 092
Cotton mills	1.834	Indian bunkers	0.150

In November, 1939, however, the Coal Mines Stowing Board was constituted by the Government for the purpose of putting out these underground fires. The activities of the board are financed from the proceeds of an excise duty levied on coal raised from mines in India, except those in Assam

As coal is by far the most important and the cheapest fuel, it goes without saying, therefore, that the modern industrial development cannot take place without coal Coal is needed for manufacturing armaments and munitions, battleships, tanks, guns, machine-guns, aeroplanes, bombs, and shells, which must be manufactured for the modern war and various types of heavy machines. All this cannot be done without coal For these manufactures raw materials and workers from long or short distances must be transported Finished products must then be transported from the factory to the field where they will be needed by the soldiers Most of this transport depends on coal mining which is the most important branch of mining industry in the country, as will be seen from the number of persons employed in mining in 1953 given in the following table.—

Employment in Mines (No)

Mineral	1953	1957	1958
Coal	3,41,193	3,70,244	3,82,172
Manganese Ore	1,10,869	1,10,214	86,857
Iron Ore	30,396	40,345	43,171
Mica	30,871	35,267	33,548
Gold	22,884	17,089	16,839
Others	.	78,162*	86,773
Total	..	6,51,321	6,49,360

* Including small-mines.

Petroleum

India's position is even worse in petroleum resources than in coal Her present production of oil, amounting to less than 1 C million tons per annum, accounts for less than 0 5% of the world's production Petroleum is becoming more and more popular every day owing to its portability and the fact that there is no wastage in its use, it is used up even to the last drop The popularity of motor transport in India, which is a country of long roads, is making the deficiency of petroleum more and more felt Petroleum is found in India in Assam, Cambay and Ankaleswar (Baroda).

Transport—A serious problem

Inadequate means of transport formulate the most frustrating problems of Coal Industry The seriousness of the problem may be assessed by the stocks of coal which have accumulated at the pitheads year by year. At the end of 1960 unmoved coal carried by all the collieries in India amounted to 3 4 million tons as against 2.68 million tons at the end of 1959. In the former case the Bihar and Bengal coal-fields showed an accumulation of over 3 million tons and in the latter case of 2 45 million tons

Assuming loading even on Sundays the total daily rail-wagon requirement would come to 6,439 wagons. But the daily average allotment of coal wagons for the whole year 1960 was 4,474 wagons and the daily loading average was 4,335 wagons in the Bengal and Bihar coal-fields. After deducting the requirement of the outlying fields, which has been assessed at 1,000 wagons, it will be evident that there is a shortfall in the supply of wagons for the movement of coal to the extent of about 1,000 wagons daily As the third Five Year Plan proceeds there will be additional requirement of wagons, which if not met properly would shake the very foundation of the Plan

The acute shortage of wagons should be made good by developing the roads of the coal-fields and those joining the outlying regions where the coal is consumed.

Another problem in Coal Industry is the growing tendency towards lawlessness, rowdyism and violence On account of such disturbances coal production has suffered a loss of about a million tons.

In the past ten years the wage bill of the colliery workers has increased more than three times without a perceptible in-

crease in their productivity. It is understood that the Ministry of Labour and Employment is contemplating the constitution of a Wage Board for the Coal Industry

For coming years gigantic increase in coal production has been planned. It will give rise to further problems Hence, it is the high time that a separate Ministry for Coal urged by the Industry for years, should now be seriously considered by the Government

The petroleum resources of India are confined to the system of folded rocks of the Arakan system on the east, including Assam and extending into Burma and the oil-fields of Sumatra, Java and Borneo These areas are the sites of ancient gulfs of the old sea Tethys.

The belt of tertiary rocks extending from the north-eastern corner of Assam for about 180 miles south, and west (290 kms) shows frequent signs of oil, nearly always in association with coal and sometimes associated with brine-springs The series of earth-folds in which this corner of Assam occurs stretches southwards to Cachar, where oil-springs are also known, through Lushai hills into Arakan In the same system of paralel folds occur the oil fields of the Arakan coast on the one side, and those of the Irrawaddy valley on the other

Oil-springs are found in various parts of Assam, the most prominent being those at the southern foot of the Khasi and the Jaintia hills, and those appearing in the coal-bearing rocks in north-east Assam, specially in the Lakhimpur district The only marketable oil obtained comes from the Lakhimpur district, where systematic drilling is conducted at Digboi The Digboi field covers an area of 2½ sq miles Here the important oil centres are Digboi, Bappapaung and Hansapung. In the Surma valley some oil of poor quality is found in Badrapur, Masimpur and Patharia The Assam fields are connected by railway and rivers. The Assam oil is mostly 'shale oil', that is, it is obtained from sand which is saturated with oil The average depth of wells varies between 1,500 to 6,500 ft. Between 1866 and 1958, about one thousand wells were sunk in Assam of which about 580 proved productive The production of oil from the present oil wells in Assam amounts to about 180,000 gallons per day.

The principal products of Assam are petrol, jute-batching oil, lubricating oils, paraffin wax and a comparatively low grade of kerosene suitable for bazaar consumption. The paraffin wax is of excellent quality and is sold in the form of candles.

An uptodate refinery near Digboi was established in 1920 to distil the crude oil with a capacity of 400,000 lakh tons per annum

*   *   *   *

India spends more than 100 crores worth of foreign exchange on the import of oil every year India's consumption of all mineral oil—kerosene, motor spirit, aviation spirit, mobile and diesel oil—require annual production of about 50 lakh tons of crude oil Of this only 4 lakh tons of crude oil is produced from Digboi. Realising the importance of mineral oil in India's developing economy, the Government of India invited a team of Soviet experts, and oil consultant from U.S A. and an eminent geologist from West Germany to advise them on the oil exploration programme According to these bodies geological mapping in vast tracts of the country covering the sub-Himalayan region in U P, the Jaiselmer area, the Gogha region of Gujarat, the Kangra-Hoshiarpur region of the Punjab, the Cambay-Kutch region on the West Coast and Assam and Ganga valley have been carried out In the basin of Ganga, the Stanvac has been prospecting over an area of about 6,000 sq miles (15480 sq. kms).

A new oil field around Naharhotiya, Hugrijan and Moran, about 20 miles (32 kms) South-west of Digboi was discovered in 1953 It is estimated to yield 2 5 million tons of crude oil a year for a period of 20 years. In all, 48 wells have so far been sunk in this region out of which 40 are oil-producing The capacity of these wells might eventually go up to 4 5 million tons

Actual drilling for oil has been carried out by the Oil and Natural Gas Commission at Jwalamukhi, Hoshiarpur, Vadeser and Cambay and by the Indo-Stanvac project in West Bengal

In Cambay at Lunej, a promising oilfield was discovered at a shallow depth of 5,368 ft Oil has also been struck at Vadeser and Ankaleswar near Baroda.

Oil exploration anywhere is full of uncertainties and risk. It is perhaps more so in India under the existing conditions Even the biggest oil companies carry out prospecting for 5 to 15 years before they abandon any area In the U S A , only one out of every 9 'wild cat' wells, produced oils Only one, out of 44 wells, finds an oilfield big enough to supply America oil for just 4 hours. The odds against finding a 50,000,000 barrel field are 991 to 1. In fact, nobody has yet been able to predict with

certainty an underground reservoir for oil merely by surface prospecting It is said, "Oil is where you find; only drilling can tell"

Three oil refineries are working in India of which two are at Trombay near Bombay and one at Vishakhapatnam The Standard Vacuum refinery at Trombay (which went into operation late in 1954) has a capacity of 1 6 million tons and involved a total capital investment of Rs 17 crores The Burma-Shell refinery at Trombay (which reached full production by the middle of 1955) has an installed capacity of about 2 million tons per annum and involved a capital outlay of Rs 33 crores The third refinery which was set up at Vishakhapatnam in 1956 by the Caltex Oil Refinery Ltd has capacity of 750,000 tons of crude oil per annum and involved a total capital outlay of about Rs 12 5 crores

All the three refineries produce motor-spirit, kerosene, high speed diesel oil, light diesel oil and bitumen For the exploitation of newly found oil fields in Assam, two more refineries have been set up at Gauhati (in Assam) with a refining capacity of 750,000 tons and an outlay of Rs 9 crores; and another at Barauni (Bihar) with a capacity of 2 million tons and a cost of Rs. 39 crores

Another refinery in the public sector with a capacity of 20 lakh tonnes per annum is being set up at Koyali near Baroda in Gujarat by ONGC with financial and technical collaboration from the U S S R authorities to process crude oil of Gujrat region

Steps are being taken to expand the Nunmati, Barauni and Koyali refineries up to 12 5, 30 and 30 lakh tonnes respectively by 1965-66 In April 1963 an agreement was signed between India and Phillips Petroleum Co of the U S A. for setting up another oil refinery at a suitable site in Cochin area, which would have a capacity of about 25 lakh tonnes per annum

A number of pipelines are proposed to be laid down to connect Gauhati and Siliguri, Calcutta Haldia and Barauni, Kanpur and Barauni and Gujarat oil fields with power stations and other consuming centres

As Indian production is too inadequate to meet the growing requirements of the country, large quantities of mineral oil are imported from Iran, Bahrein Islands, Saudi Arabia, U S A, Sumatra and Singapore.

In 1957, we imported oil worth Rs 107 crores from Middle East and the U.S A The consumption of oil is expected to go up to 14 million tons by the end of the Third Plan

HYDRO-ELECTRICITY

The supplies of coal and oil fuels are deficient in India, but there is one fuel of which there is an abundance This fuel is hydro-electricity Unfortunately, it is very little harnessed in India, due largely to the industrial backwardness of the country. Heavy rainfall, rough topography to cause water to fall, and a regular and continuous flow of water are the three important geographical requirements for developing hydro-electricity Of these the first two are found over a large part of India, but as regards the third, India is unfavourably situated The seasonal distribution of rain and its precariousness tend to make the flow of water in streams very irregular This necessitates making of high masonry dams to create artificial lakes to feed the power-house regularly The cost of hydro-electricity is, therefore, higher in India than it is in most other countries. The prices of coal in India are so low that most towns find it cheaper to generate electricity with coal than with water This is particularly so in the towns of northern India which are easily accessible and near the coalfields.

The importance of coal in the generation of electricity in India is shown by the following table

Electric Power Generation in India and its Sources

Year	Steam	%	Diesel	%	Hydro	%	Total	Electricity Generated (millions of K W A)
1957-58	1,763	60	246	8 6	1,214	42	3,223	11,320
1960-61	2,436	53	300	6 5	1,843	40	4,579	16,940
1961-62	2,466	49	317	6·3	2,234	44 4	5,017	19,680

In India the commercial energy demand is mainly supplied by coal (74 7%) followed by oil (13 4%), electricity (11.8%) and power alcohol benzol (0 1%).

In the hilly areas and in those parts of the Deccan tableland which are far away from coal, and where waterfalls are numerous, hydro-electricity is being developed where there is demand for it The larger schemes of hydro-electricity came into existence in India during the first World War when the price of coal was very high and hydro-electricity was, therefore, cheaper

Upto the mid-twenties of the present century the progress of power production was very slow. In 1925 the aggregate installed capacity was only 162341 kw. By 1945 it had increased

more than five-folds to 900402 kw At present (in March 1962) the installed capacity of power plants in the public utilities was 5016883 kw (showing an increase of about 174% since 1951). Between 1951 and 1962 (March) the generation of electricity increased from 58619 lakh kwh to 196698 lakh kwh —an increase of 236% The growth in steam, diesel, and hydro plant capacity during the same period was 125, 103 and 289 per cent

The statewise pattern of power development in India at present is as follows:[1]

Mysore Kerala, Punjab, Orissa, Jammu and Kashmir	.. Mainly hydro-electric
Bihar, West Bengal, Gujarat and Rajasthan	Largely thermal
Maharashtra, Madras, Andhra Pradesh, Uttar Pradesh, Assam, and Madhya Pradesh	. Partly thermal partly hydro-electric

The pattern of power development which has been visualised to emerge out will be one of inter-connected hydro-electric and thermal power stations in various regions—the regional systems ultimately culminating in an all-India grid

The hydro-electric works of India can be divided into three classes:—

(1) Those supplying larger industrial or commercial towns;

(2) Those connected with irrigation works, and

(3) Those supplying the hill-stations.

(1) The examples of hydro-electric works supplying large industrial commercial Towns are:—

(i) *The Tata Hydro-Electric Works* which have their power-houses near Poona and supply electricity to Bombay The water in the several lakes near Lonavla is harnessed and power transmitted to Bombay over a distance of about 70 miles by overhead wires These lakes are shown in the following map There are three power-houses at Khopoli, Bhivpuri and Bhira.

In Bombay there are three great hydro-electric works The first, Lonavla works are situated at the top of the Western Ghats where rain water is stored up in three lakes—Lonavla, Walwan and Shirvata from where it is conveyed by canals and pipelines to Khopoli at the foot of the Ghats to generate power

The Andhra Valley Power Co. is situated at Bhivpuri where rain water is stored by means of a dam across the river.

The third work lies to the south-east of Bombay on Nila Mula river.

Besides the above Stations, the Central Ry. owns a small power station at Chola lake in the Western Ghats on the Ulhas river The textile industry and the town of Bombay use this power. Thana, Kalyan, and Poona also get electricity from these stations.

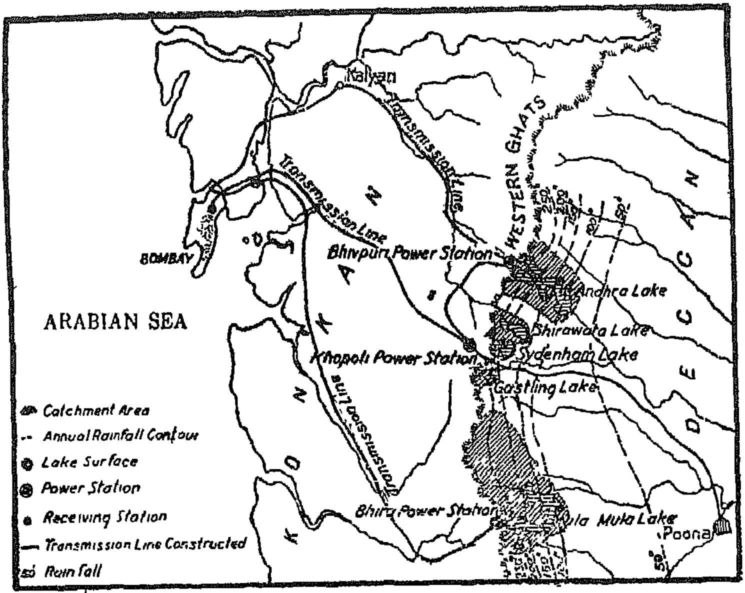


Fig 34 Tata Hydro-Electric Works

(ii) *The South Indian Hydro-Electric Works,* with their pivotal Pykara Works have an important significance in the economic life of the Madras State and Mysore. These parts of India are far away removed from coal. Most of the important towns are situated inland, away from the coast The problem of industrial fuel is, therefore, a serious one Unlike Bombay, the industrial towns of the interior cannot import coal cheaply. The progress of industry was, therefore, slow until the development of hydro-electricity solved this portion partly. The Pykara hydro-electric works was developed in 1932 on the Pykara river in the Nilgiri district. Pykara is a household word in Southern India, because it has brought prosperity to a large part of the country. The Pykara site is one of the best for power development in the world, the ultimate capacity is estimated to be 100,000 h p. Already with the completion of the present extensions the capacity of the plant is raised to 55,000 h p. The increase in the demand for power in the Tamil country compelled the Madras Government to provide urgently further

storage at Mukurti, and additional generating units. The increase in the demand for power was brought about generally by the rapid industrialisation of South India taking advantage of the availability of cheap electric power and particularly by the phenomenal development of the textile industry in Coimbatore. The power from Pykara is transmitted to Coimbatore, Erode, Tiruchirapoly, Negapatam, Madurai and Virudhnagar.

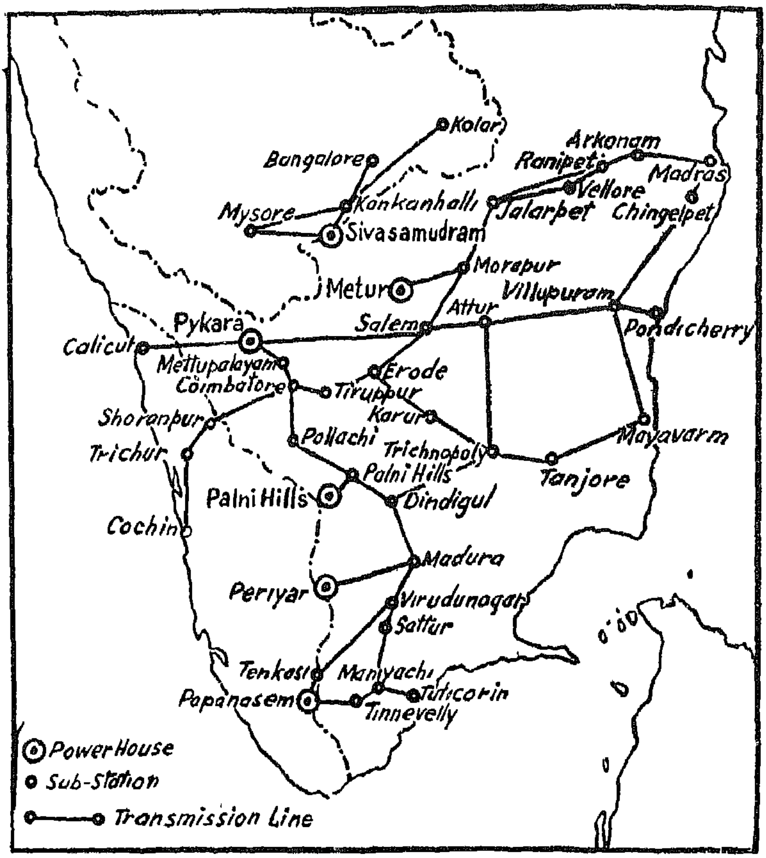


Fig 35 The South-Indian Hydro-Electric System

According to the plans of the Government the Pykara, Mettur and Papanasam Hydro-Electric lines have been interconnected to and from an electric grid, because the development of textile and other mills at Mettur, with the help of the power

generated there from the river Cauvery, was much beyond expectation, and it became clear that Mettur will not be able to meet the demand without assistance from Pykara.

This was especially so, because during the irrigation closure period, when water does not run in the canals, the capacity of the Mettur Generating Station drops from 45,000 K.W to 6,000 K W The extension of the Pykara works has, therefore, been hastened.

The Mettur Dam on R Cauvery makes a lake whose catchment area is about 16,000 sq miles. The Mettur power scheme provides the districts of Salem Tiruchirapoly, Tanjore, North and South Arcot and Chittur with energy This scheme is linked with Pykara works at Erode.

In Madras there is another scheme on the Tamraparni river at the foot-hills of the Western Ghats above Papanasam in the Tinnevelly district which supplies power to Tinnevelly, Koilpatti, Madurai, Tensaki and Rajpalayam

Madras has well developed the electricity services in its villages In Madras the textile mills, cement factories, aluminium and steel works, paper mills, and railway workshops use hydro-electric power

(iii) *The Sivasamudram works* were one of the first hydro-electric works to supply industrial power for use in the Kolar Gold Mines situated about 90 miles away. Sivasamudram supplies power to Bangalore and Mysore towns also Near Mysore another dam has been constructed at the Cauvery making a lake known as "Krishnaraja Sagar." A small amount of power is generated at this dam and is used for working the sluice gates of the canals taken out for irrigation from this Sagar This dam had been projected by Tipu Sultan, though it was not constructed in his time The main purpose of Tipu's project was irrigation. The idea of electricity was unknown then The Jog falls in Mysore are also being harnessed for electricity These falls have now been renamed as Mahatma Gandhi Falls

(iv) *Alwaye* in Travancore is another important centre for hydro-electric development in the south The power station is producing about 1,09,500 kw Out of its present production about 20,000 kw are being sent to places situated in the Madras State Most of the power generated at Alwaye is used in industries. The industries using the hydro-electricity of Alwaye are located at Trichur, Alwaye, Kottayam, Alleppy, Quillon, Trivandrum and Shencottai.

(v) *Outside the Peninsular India, Mandi Hydro-Electric works* near Jogendranagar in the Simla Hills are important The Mandi works were undertaken with very high hopes which

have not been fulfilled. They supply power for lighting and domestic purposes to some of the towns in the Punjab Kangra, Pathankot, Dhariwal, Amritsar, Moga, and Jullundhar, Gurdaspur, Gujranwala, Simla, Ambala are the chief among these towns. The supply is to be extended to Saharanpur, Delhi, Meerut, and districts of Karnal, Panipat and Rohtak

The Mandi Hydro-Electric works have been started chiefly to supply power from the Uhl river in the Mandi State This

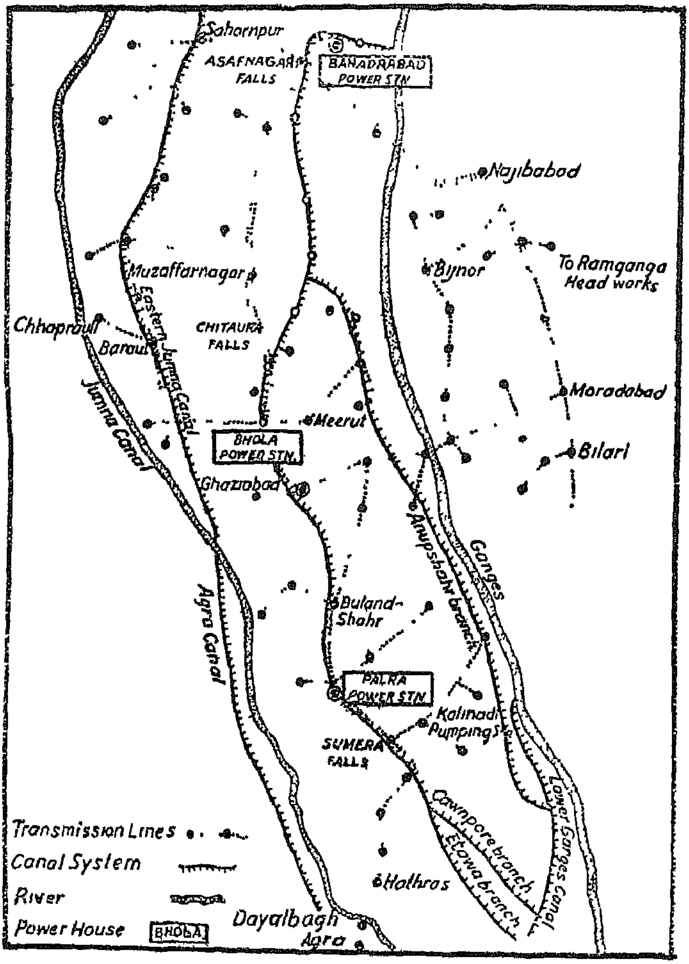


Fig 36. The Ganga Canal Hydro-Electric System

river is a small one (its catchment area is only 147 sq miles) but carries a very large amount of water. The course of the river has been changed by building a dam across it. The waters impounded by the dam are then passed through a tunnel made in the opposite direction. This tunnel is 14,212 ft. long From this tunnel the waters are led by means of huge pipes to the electricity generating works situated below in the plains near Jogendranagar. The water falls from a height of 2000 feet. The water, after its use in the works, is released for irrigating this plain.

The power is transferred by means of overhead wires through the hilly area of the Kangra Valley. Practically all the towns situated near the foot of the Himalayas in this section get power from these works It will be seen from a map of India that most of the towns of the Punjab are situated in this region.

The works are handicapped in being situated far away from the populated area of the Indo-Gangetic plains. The means of communication are difficult. The company had to finance the working of the Kangra Valley Railway which was built by the Government of India specially for the use of the works. This railway passes through the hilly area and is, therefore, very expensive to operate The cost of transport on the material required by the works must, therefore, be very high. The Mandi area is not rich in any kind of industrial raw material. The works cannot, therefore, supply power to any industrial works near about. Their market is really hundreds of miles away

The Punjab, however, which is the chief market for the Mandi works, is situated very far from coal. This fact alone makes it possible for the Mandi works to carry on profitably.

The Uhl river is producing now about 50,000 kw. Punjab gets about 10,000 kw. more from Nangal and Bhakra dams.

(vi) The Baramulla works in Kashmir must also be noted. The waters of the Jhelum river enter a gorge here and are utilized for generating electricity. The power is supplied to Srinagar and Baramulla.

(2) The most important hydro-electric works connected with irrigation works are those on the Upper Ganga canal. The power is generated from several falls on the Ganga canal The main power-house is at Bahadurabad, but the power generated at different falls is connected to a grid which serves the towns

of western U.P. The map shows these falls and the towns served by the grid. The Power Stations are situated at Bahadurabad, Mohammadpur, Nirgajni, Chitaura, Salwa, Bhola, Palra and Sumera Two thermal stations have also been erected as stand-byes. The Ganga canal system produces generally about 195 million units of electricity every year. The area served is about 1600 sq miles spread over fourteen districts of U P. There are about 95 towns receiving electricity from this system whose transmission lines run for more than 5000 miles The greatest importance of this grid lies in the fact that it enables extension of irrigation in certain areas which could not formerly be effectively served by the existing Anupshahr Branch of the Ganga canal Water is now pumped into this branch from the Kalinadi with the help of hydro-electricity. A number of tube-wells have been bored and are now worked with electricity to supply irrigation water to areas which could not be supplied with canal water.

(3) Most of the hill stations are situated in a region where water-falls are numerous, and the means of communication difficult, so that the transport of coal becomes expensive These stations find it cheaper to develop hydro-electricity. Practically all the big hill-stations, therefore, developed their own power.

Comparing the position of India with some of the countries[1] of the West, it is clear that the development of hydro-electricity here is insignificant. The ratio between the total water-power developed in various countries and their estimates of water-power is like this· Russia, 34%; France 32%, Germany and Switzerland 54%, each, Norway 53%; Canada 34%; Sweden 27%; U.S A. 24% and India only 1% This is but natural in the present state of industrial backwardness of the country. The basic importance of hydro-electricity for India must not, however, be lost sight of Nature has not endowed us with abundant supplies of coal, but she has given us an abundance of *'white coal'* whose supplies are inexhaustible in contrast with the supplies of coal which diminish as they are used.

1. Per capita generation of Electricity per head per year

Canada	5,450 kw
Norway	7,250 ,,
Japan	850 ,,
U S S. R.	960 ,,
U K	2,000 ,,
India	35 ,,
World Average	670 ,,

Bearing this fact in mind, and also that the development of hydro-electricity is separable from the development of irrigation facilities of India, the Government has formulated a number of schemes for developing hydro-electricity in different parts of the country

The following table shows the recent progress in electricity from all sources in India.

Electricity Generated in India

1948-49	..	..	4,681	million kw.
1951-52	.	..	5,948	,, ,,
1952-53	..	..	6,301	,, ,,
1953-54	..	..	6,697	,, ,,
1954-55		..	7,522	,, ,,
1955-56	.	..	8,590	,, ,,
1956-57	.	.	9,660	,, ,,
1957-58	..	..	11,320	,, ,,
1960-61		..	16,940	,, ,,
1961-62	.	.	19,680	,, ,,

The richer areas in potential hydro-electricity have practically not been tapped Assam, Orissa, Bihar and U P. possessing more than one-half of the potential resources have practically not been exploited About 80 per cent of the developed hydro-electric resources are in the Western Ghat mountains. Maharashtra, Madras, Mysore and Kerala draw their hydro-electricity practically entirely from these mountains The total installed capacity of hydro-power in S. India is about 230,000 kw although 2 million kw can be made available The reasons why the Western Ghats have been tapped for hydro-electricity to a larger extent than the Himalayas are as under:—

(1) The waterfalls situated in the Western Ghats are easily accessible, so that materials and machinery for developing hydro-electricity can be taken to them easily. (2) The rainfall in the Western Ghats is heavy and, therefore, there is no dearth of water for generating electricity. (3) The neighbourhood of the Western Ghats is industrially much developed and, therefore, there is a large market for electricity there (4) At the same time, this region lacks coal The work of coal is, therefore, taken from hydro-electricity (5) This region is a broken plateau where there are naturally many waterfalls.

The power development during the past decade has proceeded in the direction of grid systems which carry power over long distances to serve extensive areas. The regional grids have been inter-connected with one another so as to provide an interchange of power and for achieving improved efficiency and economy, reduction in standby capacity and greater security of supply The important examples of such inter-connections in India are.

(i) The Pykara, Mettur, Papansam and Madras City Schemes in Madras State;

(ii) the two tie-lines between Madras and Kerala State systems;

(iii) the linking of Jog (Mysore) and Tungabhadra (Andhra) system;

(iv) inter-connection of Nangal and Delhi power stations with a future possibility of connecting them with the western U. P. power system; and

(v) inter-connection of D V C.'s thermal and hydro stations in Bihar with the Calcutta City system.

MULTIPURPOSE PROJECTS

In post-Independence era, the various state Governments have undertaken several power and irrigation projects in hand for execution The projects are known as the 'Multi-purpose Projects.' These projects are so called because of the manifold benefits they yield. Apart from providing irrigation facilities for additional food and commercial crops, the two other main benefits they confer are the control of floods and the generation of large block of hydro-electric power. Among the other benefits which accrue from such projects are the development of internal navigation (which relieves pressure on railways), pisciculture, the provision of drinking water and the eventual development of the rivers for the purposes of recreation

At present, there are 153 projects under execution in different parts of the country. Of these 6 are multi-purpose, 140 irrigation and 43 power projects. Twelve of these 153 projects may be termed 'major'. Of the 'major' schemes 6 are multipurpose, 3 power schemes and 3 irrigation schemes. In addition there are 122 other schemes on which preliminary investigations are either in progress or have been completed and further work is in progress. Eventually these projects will irrigate 22 0 million additional acres and generate 1.5 million kw. of additional power

The following are the most important multi-purpose projects on which work is in full swing:

1. The Damodar Valley Project—in the Hooghly basin.
2. The Bhakra-Nangal Project of the Punjab
3. The Hirakud Project of the Orissa river system.
4. The Tungbhadra Project of Krishna system.
5. The Kosi Project of the Eastern Ganga basin
6. The Rihand Dam Project.
7. The Machkund Project.
8. The Kakrapara Project.
9. The Mayurakshi Project.
10. The Chambal Project.

1. *Damodar Valley Project.* Of all the projects the Damodar Valley Project is the most ambitious in outlook. For it aims not only at developing power, but also providing irrigation, controlling floods and malaria, introducing scientific management of land, promoting actively the economic development of the entire basin and improving navigability of the Damodar river. In fact, it aims at copying the famous T.V A., (Tennessee Valley Authority) of the United States of America The Damodar Valley Corporation was set up in July 1948 to execute the Damodar Valley Scheme (D.V S)

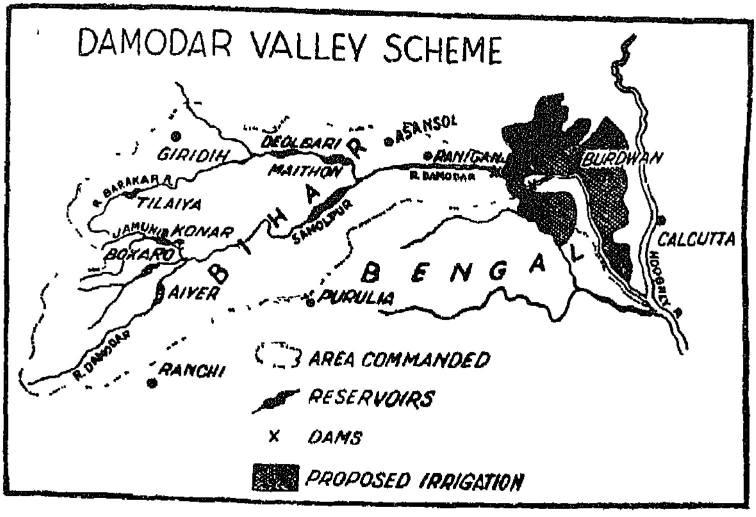


Fig. 37

The Damodar Valley Project is intended to control the Damodar river and its tributaries whose floods periodically cause

considerable damage. It envisages the construction of a series of 8 dams with hydro-electric installations. The total areas to be controlled by all the dams is 6,500 sq. miles and the water to be stored behind them will be 45 lakh acre feet. The total hydel energy to be generated will be 104,000 K W. plus 500,000 lakh K W. thermal power as Bokaro, Durgapur and Chandrapura. A network of canals and transmission lines to distribute the water and the power produced is also to be constructed.

Owing to the shortage of money, material, machinery, and men the scheme has been divided into two phases. The first phase on which work was started some years ago includes the construction of four dams at *Tilaiya*, *Konar*, *Maithan* and *Panchet Hill*, a thermal station at Bokaro, a transmission system of 470 miles, an irrigation barrage at Durgapur and a network of canals in the lower valley to irrigate over a million acres of land in the districts of Burdwan, Hooghly, Bankura, and 24 Parganas

The Tilaiya dam is located on the Barakar river about 130 miles above its confluence with the Damodar. The dam is 1147 ft. long with a maximum height of 94 ft above the bed level of the river. Its 26 sq miles reservoir will store about 320,000 acre ft of water This water will enable irrigation of nearly one lakh acres of land, *i.e.* 24,000 acres in the *kharif* and 75,000 acres in the *rabi* seasons. It was completed in 1955.

The power plant consists of two sets of 2000 kw each with provision for an addition of a third set at later stage This power station serves Hazaribagh and Kodarma towns and the mica mines Advance supply of electricity from the construction power-house at Tilaiya was given to promote land development in this area.

The Konar dam on the Konar river is situated about 15 miles above its confluence with the Damodar river. The dam will be 12,700 ft long and 160 ft high This dam is primarily intended to supply enough cooling water to the Bokaro thermal station, and the generation of about 40,000 kw. of power and provide irrigation to 104,000 acres of land. It was completed in May 1954

The Maithan dam is intended mainly for flood control. It is located on the Damodar, a few miles above the junction of the two rivers. The Maithan dam is nearly 1300 ft. long and 165 ft. high The reservoir formed by this dam has a controlled storage capacity of over 12 lakh acre ft. and about three-fourth of this capacity is reserved for flood-control. The storage available

at Maithan will enable 270,000 acres to be brought under perennial irrigation The underground hydro-electric installation has a capacity of 60,000 kw. The dam was completed in 1957, and in the power house two generating sets of 20,000 kw. each have been commissioned

The Panchet Hill dam is approximately 1800 ft. long and stores 12 lakh acre ft of water. It has a power-house with a capacity of 40,000 kw. The project will enable nearly 7 lakh acres of land to be irrigated.

Most of the land to be irrigated under the Damodar Valley scheme lies in the lower valley on both sides of the Damodar river. Although rainfall is plentiful in this region, agriculture suffers from a twofold danger—floods and failure of rainfall at the required time With the construction of flood control dams at Maithon and Panchet Hills, this danger from floods will be eliminated and the stored water will ensure adequate supply during times of failure of the rainfall. An irrigation barrage, 2,271 ft long and 38 ft. high at Durgapur was commissioned by the President in 1955 It will divert the water into two main irrigation canals on either bank and the water will be fed to the fields through a network of canals totalling to nearly 1,552 miles in length. The net irrigable area is estimated at over ten lakh acres, two-thirds of which lie in the Burdwan district and a quarter in the Hooghly district Nearly 85 miles out of 1552 miles of these canals will be navigable. The left bank canal and its main branch is also designated to serve as a navigation channel providing as alternative means of communication between the coal-fields and Calcutta The canal will have a minimum depth of 9 feet and will be capable of accommodating two lines of barge traffic This will go a long way in easing the heavy congestion on railways

The Bokaro thermal power station with an installed capacity of 1,54,000 kw. was completed in 1953. It is the biggest power station in India. The station is located just below the confluence of Konar and Bokaro rivers and ample supply of cooling water is assured by the Konar dam and also by a barrage across the river at the power station site. To keep down the cost of generation, coal supply to the power station will be from the Corporation's own mines and will be delivered through a 4½-mile aerial ropeway.

The need for the large thermal power-house at Bokaro arose to make up for the shortage of electricity in dry season In dry season, more and more water will be taken out from the canals for irrigation leaving less water for producing electricity.

The hydro-electric installations at the various dams and the Bokaro thermal power station of the Damodar Valley Scheme will be linked by many transmission lines. Power will be distributed through an extensive network The Loyabad-Sindri-Maithon section of the main transmission line (39 miles long) is complete These lines are being completed urgently to distribute in the coal-field area 22,500 kw. of power which is being obtained from the Sindri Fertilizer Factory Power Station.

A special feature of the Damodar Valley Project is that benefits accrue as each component part is completed. Thus Tilaiya will provide water and assure full irrigation of the area now served by the Anderson Weir. With the completion of Konar there will be sufficient water to put the whole of this area under Rabi. Power is already being supplied to the Chittranjan Locomotive Works and the Kodarma Mica Mines. It has been estimated that the Damodar region will require about 3 lakh kw. But it will take some time before the full demand for power arises. The following map gives a rough idea of the project:—

The D.V.C. Scheme is estimated to cost Rs. 103 93 crores It will give irrigational facilities to 10 25 lakh acres of land and generate nearly 254,000 kw on completion

2. *The Bhakra-Nangal Project.* Though conceived in 1900 it was not until 1946 that this multi-purpose project was undertaken. It consists of.

(1) the Bhakra Dam 740 ft. high and 1700 ft long and the width of base at its widest point in about 1,100 ft.—across the

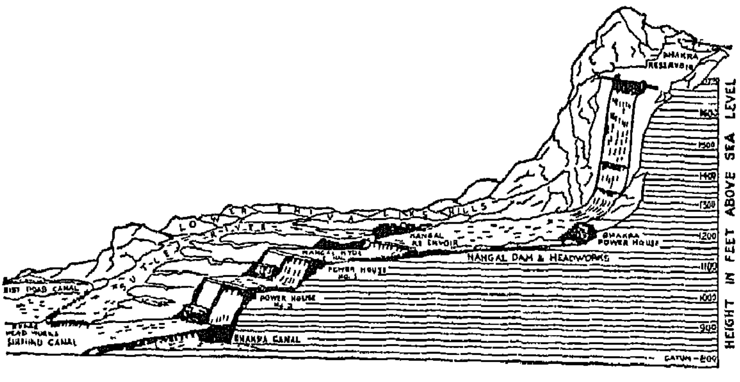


Fig 38. A diagramatiatic Sketch of Bhakra-Nangal Dam

River Sutlej at the site of Bhakra Gorge, about 50 miles upstream in Ambala district of the Punjab This dam will form a lake 5 miles wide and 50 miles long—Govindsagar lake—the storage capacity of this reservoir is estimated to be 7 2 million cu. ft. of which nearly 5 5 m cu ft. will be available for hydroelectric power generation and irrigation purposes every year This dam would rank as the highest straightway gravity dam in the world. During construction of the dam the river will be diverted through two 50 ft diameter diversion tunnels, one on the right and the other on the left, going through hill side Each tunnel will be about a half mile long. It will have about 650 miles of canals and over 2,000 miles of distributories.

(2) The Nangal dam has been made across the river at Nangal, about 8 miles down-stream from Bhakra This dam is a massive concrete weir 1,029 ft long, 400 ft. wide and with its deepest foundation going down to 50 ft below the river bed.

(3) The above will divert the river into the Nangal hydroelectric canal This waterway is about 40 miles long and 28 ft deep. It has been cemented throughout its length The dam will serve as a balancing reservoir for taking up daily fluctuations from the Bhakra dam and for meeting daily and weekly load variations or power-houses on the Nangal hydro-electric canal.

(4) Two power-houses—one at Ganguwal 12 miles away from Nangal and the other at Kotla—6 miles off from Ganguwal. This system will supply power to Rupar, Ambala, Karnal, Panipat, Hissar, Baivani, Rohtak, Nabha, Patiala, Ferozpore, Faridkot, Kalka, Kasauli, Simla, Jullunder, Kapurthala and 50 other small cities Recently the electric power has been extended to Delhi, Gurgaon, Palwal and Rewari The power will also be used for tube-well irrigation and for railway electrification especially on the main line between Delhi and Amritsar They have a combined installed capacity of 60,400 km. and a total firm capacity of 337 Mw.

It is proposed to construct another power-house on the right bank of the Sutlej. Its estimated cost would be about Rs. 26 crores and it will have five generating units of 120 Mw each.

In 1957-58, an area of about 15 lakh acres was irrigated by Bhakra canal system in the Punjab and Rajasthan The canal system commands a gross area of about 66 7 lakh acres

The project will irrigate 3 6 million acres of land in the Punjab and Rajasthan and will generate 332,000 kw of power. In addition, an area of 37 lakh acres will get increased water supply. It is anticipated that, on full development, there will

be an additional outturn of 8 5 lakh tons of wheat and other foodgrains 5.9 lakh tons, bales of cotton, 1 5 lakh tons of sugar-cane and 0.3 lakh tons of pulses and oilseeds.

3. *The Hirakud Project.* In Orissa it is the first of a chain of three dams planned for harnessing the waters of Mahanadi. At a point about 9 miles from Sambalpur, at Hirakud, the first dam will be constructed on the Mahanadi This dam is to be 3 miles long, flanked by 2 dykes 6¼ miles long on the right and 6¼ miles long on the left. This dam will be 195 ft above the river-bed This dam will be longest in the world and will form a 250 sq. miles lake with a storage capacity of 66 lakh acre-feet of water. The area covered by the dam and the dykes comes to about 22 miles. There will be three flow-canals—2 from the left dyke and one from the right dyke. A power-house containing 4 units with the capacity of producing 123,000 kwh has already been commissioned

The second dam on this river will be at Tikkarpara and the third at Naraj Later on dams will be constructed on the Ibb and Mand which are northern tributaries of Mahanadi; and on the Tel river which is its southern tributary

This project is being executed by the Central Government on behalf of the Government of Orissa The main dam and dykes have already been completed and irrigation facilities had been provided for 241,983 acres of land The power-house has begun supplying power to a considerable extent

After full completion it will provide irrigation to 18 lakh acres of land, and provide 350,000 kw. of electricity and also provide navigation facilities in Mahanadi—as the river will be deepened from Naraj up to 400 miles by 9 ft. so that sea-going vessels could reach the interior part of the valley. The project likely to be completed soon is expected to cost about Rs. 70 78 crores.

The power is being supplied to the cement factory at Rajgangpur, the steel works at Rourkela, the ferro-manganese plant at Joda, the paper mills at Brijrajnagar and textile and other industries in and around Chawdhar. The towns of Cuttuck, Puri, Sambalpur, Sundergarh, Bargarh and several other places are getting power from Hirakud

4 *The Tungabhadra Project.* This project envisages a dam across the Tungabhadra river near Mallapuram, 3 miles above Hospet, in Bellary district This project serves Mysore and Andhra Pradesh This is a joint undertaking of the Government of Mysore and Andhra It comprises a dam 7,942 ft long and 162 ft high The dam was inaugurated on July, 1953.

The reservoir, which has a water-spread of 146 sq miles, will ultimately store 30-lakh acre-feet of water The two canals on either side will irrigate nearly 8 3 lakh acres in Mysore and Andhra. There will be two power-stations on the Andhra-Mysore side one below the dam and the other at the end of a 15-mile canal at Bubhasagaram The stations with two generating units of 9,000 kw each have been commissioned A hydro-electric station constructed below the dam on the Andhra side also, with two generators, of 9,000 kw each will be installed in the first instance.

The project will cost about 45.1 crores of rupees On completion nearly 828,503 acres of land will be irrigated and, in total, about 63,000 kw. of power will be generated

5 *Kosi Project.* Kosi is one of the most furious rivers in India, which has been destroying the entire economic structure of the areas which became victims of its spate every year Hence, for taming this river and protecting its valley from the floods a project was prepared in 1950 envisaging the construction of the project in seven stages at an estimated cost of Rs. 177 crores. This project is a multi-purpose project for irrigation, power, navigation, flood control, silt control, soil conservation, drainage, reclamation of water-logged areas, malaria control, fish culture and recreation facilities

The construction of the embankments was started in 1955 This project will comprise a dam about 750 ft high across the Chatra Gorge in Nepal to store about 11 million acre-feet of water There will be two barrages on the Kosi (i) the first one in Nepal at Hanuman Nagar to control and stabilise the river channel and will divert its supplies into two canals on either side of the river About a million acres will be irrigated by these two canals in Nepal, (ii) the second barrage will be near Nepal-Bihar border, where two canals on the left and one on the right will be constructed for irrigating over 2 million acres in the districts of Purnea, Darbhanga and Muzaffarpur in Bihar Eastern Kosi Canal will take off from Hanumannagar Barrage. It will have branches—Murliganj Branch, Jankinagar Branch, Banmankhi Branch and Araria Branch

On its completion, irrigation facilities will be provided to nearly 13 97 lakh acres. The greater advantage that is being envisaged from this project is that about 75,000 cusecs of flood water would be diverted into old water-bed, thus, preventing the floods and protecting nearly 2,000 sq miles of land The power plant at the dam site will be capable of generating 1 8 million kw of power It is expected to be completed by 1965 and is estimated to cost Rs 68 crores.

Flood embankments protecting nearly 8000 sq. miles in Nepal and India were completed in 1959.

6. *Rihand Dam Project.* The work though contemplated as early as December, 1947 was actually started only after October, 1951 The project comprises of a concrete gravity dam across the Rihand river at Pipri which will be 3,524 feet long and 300 feet high with a storage capacity of about 86 lakh acre-feet of water The surface area of the lake created will be 180 sq miles.

(i) This project will enable 4,000 tube-wells to function for irrigating 14 lakh acres of land in U P. and 5 lakh acres in Bihar, and 4,000 miles of pumped canals from the Gogra, Ganga and Jamuna rivers.

(ii) Fish culture will be possible in the huge lake.

(iii) The canals will bring the unexplored region of the Sone valley in touch with the Ganga Large cargo vessels will ply between the Hooghly and the Rihand

(iv) A power-house at the base of the dam will be designed to house 6 generating sets with an initial installed capacity of 2.5 lakh kw and an ultimate capacity of 3 lakh kw

(v) Power will be used for large-scale industrial development, such as production of aluminium, caustic soda, chlorine, paper, fertilizers, plastics and textiles, will find economic factors to be suitable in the neighbourhood of the Project area

(vi) Some sections of the railways will be electrified to save coal. The power raised from the water will result in the saving of 20,000 wagons of coal per year.

(vii) It will encourage afforestation in Rewa and restoration in marginal lands besides reducing soil erosion and controlling the floods in the Rihand and the Sone. This will cost 46 05 crores of rupees

7. *The Machkund Project* is a joint scheme of Andhra and Orissa. This hydro-electric scheme harnesses the waters of the river Machkund on the boundary between the two states. A 176-foot high and 1,345 ft long storage dam has been constructed at Jalalpur on Machkund river to store 625,000 acre-feet of water The site of the power-house is at Duduma Falls, about 125 miles from Vishakhapatnam by road. Three generating units, each with a capacity of 17,000 kw are already operating Later on, three more units will be installed and the total power output brought to 114,750 kw. The Project will cost about Rs. 13 60 crores for generation only. One set was formally commissioned by the President in August, 1955.

8 *Kakrapara Project*. It may be regarded as the first phase of the development of the Tapti Valley. The construction of a weir, 2,038 ft long and 45 ft high, on the rocky river bed near Kakrapara across R Tapti, 50 miles upstream of Surat, was completed in June, 1953. It has two canals, one on each side The scheme is expected to irrigate about 6 53 lakh acres in Surat district and is expected to generate about 48,000 kw. of power.

9. *Mayurakshi Project* undertaken by the West Bengal Government is mainly an irrigation project, though it also provides for the installation of a 4,000 kw hydro-electric plant The power will be supplied to Birbhum and Murshidabad districts in West Bengal and Santhal Parganas in Bihar The first stage of the Project was completed in 1951 with the construction of diversion barrage at Tilpara near Suri in Bengal The 155 ft. high and 2,170 ft long *Massanjore Dam* was completed in June, 1955 The canals on either side will irrigate 6 5 lakh acres of land A storage dam proposed for the Mayurakshi will have a capacity of 5-lakh acre—feet of water and will provide *rabi* irrigation to nearly 50,000 acres The first 2,000 kw. generating set was commissioned in December, 1956 and the second in February, 1957

10. *The Chambal Project* Chambal is the largest river in MP. and Rajasthan having its origin in the Vindhya range and falling into the Yamuna after flowing for over 600 miles The river has a fall of about 2400 ft The river flows over rocky surface and its banks are 2 to 300 ft. high The river is 2500 ft. wide but at Chawrasigarh the gorge narrows down to a mere 600 ft This river has a total drainage area of 55,000 sq. miles. The dam sites have been selected at 3 places— below Chawrasigarh fort, above Chulia falls and above Kota city—for power development and for irrigation a barrage 2000 ft long will be constructed About two canals will be dug from above the barrage, one on the left side towards Bundi, and the other on the righ side through Kota to MP 6 miles downstream of Kotah, with canals commanding over a million acres of land and will produce about 4 lakh tons of foodgrains

The first dam named after Mahatma Gandhi is being constructed near Chawrasigarh The Gandhi Sagar Dam will be 1750 ft long and 200 ft high above the bed of the river It will hold about 68 5 lakh acre-feet of water. The surface area of the lake would measure 225 sq miles About 80,000 kws of power will be generated and this dam will cost 10½ crores of rupees Nearly 170 villages and 25,000 people are likely to be affected by this development.

The Gandhi Sagar Dam and power station with three units have been completed and power generation was started from 19th day of November, 1960. The Kotah barrage has also been completed and water for irrigation was released on 20th November, 1960

The second dam above the Chulia falls has been named the Rana Pratap Sagar Dam and the associated power project (the Bhupal Power Project) This dam will be 3,500 ft. long, and 90 ft high above the average river bed It will submerge about 60 sq miles and will impound about 1 40 million acre-feet of water. Water from this reservoir will be taken by means of two 15' diameter concrete conduits, 6800 ft long into a surge tank and thence through steel pen-stock pipes to the power-house about 3 miles above Bhainsrodgarh It will generate 90,000 kw of power and will be ready by 1961-62

The third dam will be known as Kotah Dam and will be built in the river gorge about 10 miles north of Kota city It will be 150 ft. high, 80 ft wide and 1800 ft. long It will generate 50,000 kw of power.

The whole project will cost about Rs 50 crores in all, out of which Rs 40 crores will be shared by Central Government and Rs 5 crores each by Madhya Pradesh and Rajasthan Governments It will provide water to over a million acres of land and will produce 4 lakh tons of foodgrains besides supplying an ultimate capacity of 2 lakh kw of power This power will be supplied to Sambhar Salt Lakes, marble mines of Makrana, soap-stone mines of Jaipur and Bhilwara; and to Zawar mines and cement factory of Lakheri and to cotton textile and mills of Kota, Kishangarh, Bhilwara and Jaipur.

POWER IN M. P

Madhya Pradesh is one of the richest states of Indian Republic in mineral resources, and yet it is one of the most backward in Power Development Nature has endowed it with both basic and key materials such as iron, coal, bauxite, manganese, etc Coal is found in abundance The coal deposits of the state occur in three areas. (i) the Pench-Kanhan Valley, approximately 100 miles to the north of Nagpur, (ii) the Wardha basin, about 100 miles to the south of Nagpur, and (iii) the Chirimiri region in the eastern part of the state These are at present being worked The coal deposits found in the vicinity of Nagpur and Kamptee are yet to be worked. The State has an assured rainfall Its river systems—the Narbada, the Tapti, the Mahanadi, the Wardha, the Wainganga, the Indravati—offer opportunities for multi-purpose development yielding power and irrigation,

But the pre-condition of any developmental plan is the availability of cheap power. The harnessing of the state river system could no doubt form the major sources of power-generation, but it is essentially a long-term measure. Large outlay is involved necessitating building up in advance a large electrical load and efforts to utilise any surplus power that may be there The load consists of textile mills, ginning and pressing of cotton, Rice mills, oil mills, hydrogenation of oil industry, paper mills, cement mills, newsprint and paper mills, manganese mining, collieries, aluminium, and steel and other industries.

But so far the development of electric supply in the state has been very slow Introduced first for public supply in 1902 the total installed capacity of public supply undertakings in Madhya Pradesh upto 1938-39 was only 11,030 k.w This was stepped up later for war purposes during the period 1939-1944 The present capacity is 26,485 kw The bulk of this is concentrated at Nagpur, Jabalpur and Katni The state as a whole, however, still remains power-starved. The total capacity of pri-

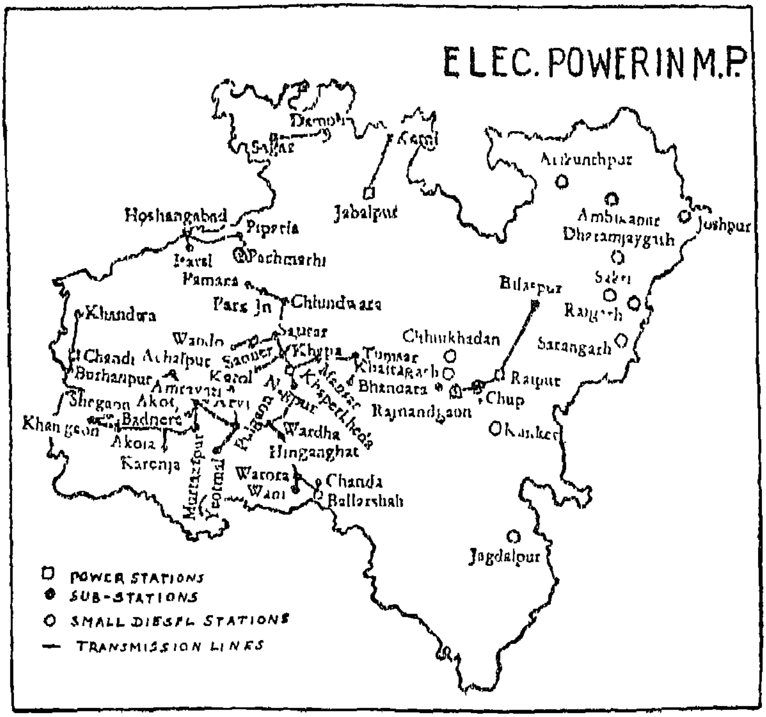


Fig 39.

vate-owned electricity installations is 29,484 kw making an overall availability of power in the state to the extent of 55,969 kw only There is still a big gap between the supply and the demand for power This cannot continue without detriment to the economic and industrial progress of the state.

As an immediate measure, therefore, Government decided to develop thermal power scheme and in 1945 invited the eminent electrical engineer, Sir Henry Howard from Madras to formulate an appropriate plan Some of his principal recommendations were as follows —(1) to divide the state into five power districts—Nagpur, Chanda, Akola, Jabalpur (northern) and Raipur (2) A power system in each district based in existing loads from suitably located thermal stations in each district (3) These to be inter-connected at future date by trunk mains and neighbouring systems across the state border.

Accepting the recommendations in principle, the Government announced their decision in 1945 of establishing a central thermal electrical station near Nagpur with an installed capacity of 20,000 kw, capable of future expansion to 60,000 kw.

As a prerequisite for such a development was evolved a five-year development plan ending in 1952 for providing the nucleus of a State electricity supply system to cover as wide an area as possible in the quickest possible time and ensure a reasonably cheap and abundant supply of electricity. For purposes of power development M P is divided into 3 grid systems —southern, northern, eastern They are at the moment independent, each fed by one or more central thermal stations, to be later inter-connected by provincial trunk mains, to the sources of water-power potential and to neighbouring systems at state borders Work is in progress on all these schemes Places not reached by the nucleus grid will be developed by setting up small local thermal (diesel) generating stations and be later linked to the grid schemes The aim here is to provide electricity to towns having a population of 10,000 and over, and to as many of major villages as possible, in course of time Besides, the Government have a scheme under consideration for intensive rural electrification in certain selected areas.

The Khaperkheda station forms part of the southern grid system. Situated on the right bank of the Kanhan river approximately four miles from Kamptee and ten miles from Nagpur, it has direct rail connection with the Pench valley coal-fields in the north, and the Wardha basin in the south Enough coal deposits exist in and around the site, working is not difficult and cost of coal will be cheap. Water in the river is plentiful and permits of enlarging the station to any reasonable degree,

In such a set-up, the Khaperkheda station is designed to operate as a base. In planning the station the Government have also in view the growth of industries in the vicinity. They have, therefore, provided for a planned township

With an operational capacity of 20,000 kw. the load expectation within the next few years from the power station is 42,900 kw. When it starts functioning, 16 new towns will, for the first time, begin to receive electricity, 11 out of the 16 electric supply companies in the areas served by the station will have stopped generation although continuing as distributing units, out of the 9 textile mills within its range, 4 with 12,000 kw and approximately 1000 H P requirement will be changed over to the grid supply and all the 4 private generating stations in the coal-fields with an installed capacity of 3,200 kw and the new major mines not yet electrified requiring another 2,000 kw (practically all the Pench fields and Wardha basin) will begin to be fed by this central station

The station is expected to rationalise the power situation in the state Together with the projected station in the Chanda-Ballarshah power district and the station at Chandni to which it will be inter-connected, Khaperkheda will make available an economical and widespread supply of electricity in the Nagpur and Berar divisions or in other words, the southern and western parts of the state Power-feeders take off from the station in all the four directions—to Pench Valley in the north, to Akola, west Berar and Nimar in the west (in association with Chandni station), to Ballarshah in the south branching from Wardha, and to the manganese belt in the east which will in course of time extend to the Balaghat-Balhar plateau and the Bhandara district The mining and textile industries and the electric supply companies have already taken advantage of it and are fast entering into contracts for supply from the Government grid In fact, the entire capacity of the Khaperkheda station is already fully booked

The towns that received electricity supply for the first time from the station are Ramtek, Tumsar, Bhandara, Kamptee-Kanhan, Warora, Wun, Ballarpur, Pulgaon, Dhamangaon, Badnera, Murtizapur, Achalpur, Saoner, Khapa, Sausar and Jamal-Parasia An extension of the supply to the rural parts immediately in the Saoner Katol-Warud area is under active consideration The Government grid scheme is intended to supply electricity by and by to all rural areas an a planned development in zones of 20-mile radius around each main sub-station location

POWER DEVELOPMENT UNDER THE PLANS

The total river water resources in India were computed a few years ago at 1,356 million acre feet Of this volume of water only 76 million acre-feet (5.6%) is at present being utilised for the purpose of irrigation and water-power generation and the remaining 94 4% runs to waste, causing untold damage before it enters the sea

Water Resources of India

		Catchment area sq miles (000)	Normal Rain in inches	Mean Temp F	Loss (inches)	Run off (inches)	Run off (mil-Acre Ft) Annual	Used for Irrigation (Mil. Acre Feet)
1	Rivers falling into Arabian Sea (Exc Indus)	190	48	78	23	25	251	11
2.	Indus Basin in India	136	22	55	13	9	64	11
3	Rivers falling in Bay of Bengal (Exc. Ganga and Brahmaputra)	467	42	79	29	13	334	23
4.	Ganga System	377	44	62	24	20	397	26
5	Brahmaputra System	195	48	47	18	30	309	3
6	Rajasthan	65	11	79	11			
		1430					1355	74

The position in regard to ultilization of water resources in the important river basins will be as set out below:—

River System	Estimated Average flow	Utiliza-tion up to 1951	Additional Utilization by Projects entered in I Plan	Additional Utilization by Projects entered in II Plan
Indus	168	8 0	11 0	1 2
Ganga	400	20 0	21 5	14 5
Brahmaputra	300	Nil	Nil	Nil
Godavari ..	84	12·0	1 0	1 5
Mahanadi .	84	0 6	10 5	0 2
Krishna .	50	9 2	15 6	2 6
Narmada .	32	0·2	Nil	10 1
Tapti .	17	0 2	0 7	3 1
Cauvery	12	8·0	1 3	0 6

Attempts have been made to make assessment of the hydro-electric potential in the country It has been estimated that the total hydro-electric potential, which it might be possible to develop from various sites, is about 35 million Kw This includes about 4 million kw from the west flowing rivers, and about 7 million kw. from the east flowing rivers of the southern region, about four million kw. from the Narbada, Tapti, Mahanadi, Brahminini and Baitarni basins in the central region and about 20 million kw. from Ganga, Brahmaputra, Indus and other Himalayan rivers in the northern and north-eastern regions.

At the beginning of the First Plan, the total installed capacity of the power-generating plants amounted only to 2.3 million kw. At the end of the First Plan the aggregate installed generating capacity increased by 1 1 million kw or by 49% By the end of the Second Plan there was an increase of 64% in the generating capacity which increased from 3 4 million kw. to 5.6 million kw. The Third Plan target of generating capacity has been fixed at 13.4 million kw of which 12 7 million kw will be in commercial operation At the end of the Third Plan, per capita generation of electricity has been visualised to be about 95 kwh whereas in 1951 it was 18 kwh , in 1956, 28 kwh ; and in 1961, 45 kwh. The cost of the power programme in the public sector in the Third Plan has been estimated to be Rs 1039 crores; and in the private sector Rs 50 crores

The principal power schemes completed and brought into service during the First Plan are.—

Nangal (Punjab) . .	48,000	kw.
Bokaro (Bihar) .	150,000	"
Chola (Kalyan, Bombay) .	54,000	"
Khaperkheda (M. P.)	30,000	"
Moyar (Madras) . .	36,000	"
Madras City Plant Extensions (Madras)	30,000	"
Machkund (Andhra and Orissa)	34,000	"
Pathri (U.P.) . .	13,600	"
Sarda (U P) . .	27,600	"
Sengulam (Kerala)	48,300	"
Jog (Madras)	72,000	"

In addition, considerable progress has been made on a number of major projects which have been completed during the Second Plan.

In order to meet the demand of the new industries and the normal load growth and expansion of the existing power systems, it has been decided to raise the installed capacity in the country to 6 9 million kw. representing over a 100% increase in the generating capacity at the end of the First Plan—that is, there will be an additional generating capacity of 3.5 million kw during the Second plan. The power schemes for the Second Plan have been co-ordinated with regional requirements and available resources. Of the 44 new power schemes, 10 will cost over Rs 10 crores each ; 4 between Rs 5 and Rs. 10 crores , 18 between Rs 1 and 5 crores and 12 less than Rs. 1 crore, 25 are hydro-electric schemes, yielding about 2 2 million kw. and 19 thermal stations yielding 1 3 million kw.

In the Third Plan principal power generation schemes which are continuing are as follows

Tungabhadra, hydel project (stage II), Nellore thermal station, Panniar hydel project, Gandhisagar dam power station IV unit, Kundah hydel project, Koyna hydel project stage I, Purna hydel project, Tungabhadra left bank power—house, Hirakud hydel project, Bhakra-Nangal project, Rana Pratap Sagar dam power—house, Rihand hydel project, Matatila hydel project, Yamuna hydel project, Ramganga hydel project, and Kosi project etc

The principal new schemes which are being undertaken in the Third Plan are

Nagarjuna Sagar hydel project (Andhra Pradesh), Srisailam hydel project (Andhra Pradesh), Umiam hydel project stage II (Assam), Kopili hydel project (Assam), Thermal extensions in D.V C area, Gandak hydel project (Bihar), Chenani hydel project (Jammu & Kashmir), Jhelum hydel Project (Jammu & Kashmir), Tawa hydel project, Kundah hydel project, Periyar hydel project, Koyna project, stage II, Bhakra right bank power house, Beas project stage I, Kotah project and Gandhi Sugar V unit etc

Broadly speaking, most of the electrical developments in India has so far been limited to satisfying the needs of the urban areas This has led to a lopsided development of our economy It may be pointed out that 6 large cities—Bombay, Calcutta, Kanpur, Ahmedabad, Madras and Delhi—account for 51% of the country's installed capacity and 54% of the generated energy However, a few larger power systems serve the needs of rural areas also Hitherto rural electrification has made headway only in the Punjab, Madras, Mysore. Kerala and U P There

has been a marked increase in the number of Towns and villages which are served with electric power, as will be clear from the following table:—

Population Range	Total No 1951 Census	Number electrified by March, 31			
		1951	1956	1961	1966 estimated
Over 1,00,000	73	49	73	73	73
50,000 to 1,00,000	111	88	111	111	111
10,000 to 50,000	1,257	500	716	1,176	1,257
below 10,000	5,59,665	3,050	6,500	25,410	41,559
Total	5,61,106	3,687	7,400	26,825	43,000

During the First Plan period, the actual number of electrified towns and villages with a population of less than 10,000 increased from 3050 in 1951, to 6500 in 1956 and 25470 in 1961 It is proposed to increase the number to 41559 in 1966 which makes it clear that in recent years there has been greater stress on rural electrification

Development programme. The total installed generating capacity stood at 23 lakh kilowatts during the First Plan and there was an increase by 49% during the same period. During the IInd Plan the generating capacity rose from 34 2 lakh kw. to 56 lakh kw. *i.e.*, increase by 64%. By the end of the IIIrd Plan it is expected that total capacity of the plants in commission would be 134 lakh kilowatts and thus per capita generation of electricity would increase from 18 kwh. in 1957 to 95 kwh. in 1966

It is estimated that during IIIrd Plan about Rs 1,039 crores would be spent on power programmes in the public sector while in the private sector the amount is supposed to be near about Rs. 50 crores

Two nuclear power plants are to be erected one at Tarapur (near Bombay) and the other near Rana Pratap Sagar dam. Both the above plants will produce 150 mw of power.

QUESTIONS

1 How far do you think the power resources of India to be sufficient for her industrial needs

2 What is the extent of coal resources in India Where are the main deposits of coal in India found?

3 What geographical or economic drawbacks has the Indian coal industry to face? What remedies can you suggest?

4. What is the extent of Petroleum resources in India?

5 Where is hydro-electricity highly developed in India? What factors favour it there?

6 On what grounds will you recommend greater use of soft-coke in Indian Homes?

7. Describe and explain the utilization of water-power resources in India with special reference to the Punjab

8 Describe the geographical factors involved in the use of hydro-electric power in India.

Chapter 8

Industrial Ores

Metallic ores occupy the basic position in the economic life of the modern world There are numerous uses to which the ores are put, but their greatest use is in the manufacture of machinery without which the wheels of the world cannot go on The ores are found associated with the oldest rocks of the world. Here in India the system of rocks named *Dharwarian* is the most widely occurring of such rocks. It is probably of the same age as the Archaen rocks which are believed to be the first solidified crust of the earth. The Dharwar system of rocks carries the principal ore-deposits of India. This rock occurs mostly in the Peninsular part of India.

In 1961 nearly 671,000 persons were engaged in mining and there were 3,200 working mines The more important mining centres are in Bihar, Orissa, West Bengal, Rajasthan, Mysore and Andhra and the more extensively worked minerals are coal (854 mines), mica (718 mines), manganese ore (551 mines), iron ore (289 mines), and limestone (more than 155 mines), Gypsum (39 mines) and bauxite (46 mines)

The value of mineral production in India during 1961 was Rs 176 crores as against Rs 164 crores in 1960—an increase about 7% The total value of mineral production (including coal since 1901) is given as follows·

Year	Value (Rs. lakhs)	Year	Value (Rs. lakhs)
1901	670	1950	7,160
1911	1,140	1955	9,440
1921	3,290	1956	10,870
1931	2,390	1957	12,720
1939	2,020	1958	13,100
1948	6,400	1961	17,640

Quantity and Value of Mineral Produced *(value in 000 Rs.)

	Unit of Quantity	1960 Quantity	1960 Value	1961 Quantity	1961 Value
Coal .	'000 Tonnes	52,593	10,88,447	56,065	11,71,939
Metallic Minerals					
Ferrous :					
Chromite ..	Tonnes	1,00,112	5,733	45,926	2,707
Iron Ore .	'000 Tonnes	10,683	90,285	12,270	1,02,039
Manganese Ore	'000 Tonnes	1,199	82,743	1,230	75,721
Non-Ferrous :					
Bauxite ..	'000 Tonnes	387	4,089	476	4,683
Copper Ore	'000 Tonnes	448	23,736	423	22,981
Gold ..	Kgs	4,995	56,674	4,868	59,103
Ilmenite .	'000 Tonnes	250	14,695	174	10,264
Lead, (Concentrate)	Tonnes	6,245	2,231	5,532	1,691
Silver ..	Kgs	412	780	5,941	1,197
Zinc (Concentrate)		9,787	2,544	9,254	2,212
Non-Metallic Minerals .					
Diamond ..	Carets	1,159	529	1,313	853 (estimated)
Magnesite ..	Tonnes	1,56,331	2,683	2,09,744	3,477
Mica (Crude)..	'000 Cwts	29,226	24,732	28,347	23,658
Gypsum	'000 Tonnes	997	6,240	866	5,356
Salt (others)	'000 Tonnes	3,431	66,922	3,462	76,180
Salt (rock)	'000 Tonnes	4,311	186	4,300	227

1. Iron

Bihar, Orissa and Mysore are the only parts of India in which large quantities of iron-ore are mined Elsewhere specially in Hyderabad and Madhya Pradesh small quantities are mined for use in indigenous iron works The most important iron-ore area in India is situated about 150 to 200 miles to the west of Calcutta in Bihar and Orissa, and contains large and rich deposits of iron-ore. The deposits occur in the Kolhan Government Estate in the Singhbhum district, and also in Keonjhar, Bonai and Mayurbhanj These ores are remarkable for the enormous quantities of extremely rich ore which will one day

* India 1963 p 277 1 tonne=1,000 kg
1 ton.=1016 kg. (or tonne 1 tonne=0 9842 ton)

undoubtedly prove to be among the largest and the richest in the world The iron ore usually occurs at or near the tops of hills Near Jamda in the south of the Singhbhum district and in parts of Keonjhar, however, it is often found at lower slopes and in some cases actually in the plains themselves.

The most important of these ranges of hills containing iron-ore is the one that starts near Kompilai in Boni and continues for a distance of about 30 miles towards Gua Running more or less parallel to this range, and possibly faulted from it, are other smaller ranges which contain good iron-ore The main range rises some 1,500 ft. above the plain and the ore averages over 60% of iron for practically the whole length of it To the east and west of these hill ranges, there are more irregular patches of ore occupying the tops of hills Practically the whole of the ore is haematite and as far as is known, no quantity of magnetic occurs there

The minimum quantities of ore reserves averaging not less than 60% iron are estimated as follows .—

Singhbhum District	1,047	Million	Tons
Keonjhar	988	"	"
Bonai ..	648	"	"
Mayurbhanj	18	"	"

According to latest estimates these figures have been revised and deposits amount to about 6,500 million tons with a possible reserve of another 21,000 million tons

The iron ores in India are of three major grades, Haematite, Magnetite, and Limonitic

(i) The *Haematite ores* are at present worked in Singhbhum, Keonjhar and Mayurbhanj districts as well as in the Bababudan hills of Mysore They are rich in iron (60 to 69 p c) and include massive, hard and compact ores as well as shaly and powdery type The powdery type is not being utilized at present but the mining concerns were aware of their high quality All the deposits now being worked are on top of hills and ridges

(ii) The *Magnetite ores* of igneous origin are found in S E Singhbhum and the adjacent parts of Mayurbhanj. Our knowledge of these is not sufficiently detailed for an estimate of the reserves, but it is stated that in one deposit at Kumardhubi about a million tons of ore are found at the surface These magnetite ores are particularly interesting because of their titanium, vanadium and chromium content

(iii) The *Ironstone shale* group of the Raniganj coal-field, forming a stratigraphic unit between Barakar coal measures and the Raniganj coal measures, has a thickness of about 1,200 feet and stretches over a length of some 33 miles in an east-west direction Sideritic iron-ore occurs in these shales as numerous thin bands These ores used to be worked near Kulti for feeding the blast furnaces of the Bengal Iron Co up to about 1913 In that year they were replaced by much richer ores of Singhbhum obtained from quarries developed into limonite near the surface.

In view of the fact that there are large reserves of excellent haematite available within short distances of the coal-fields, the ironstones of the Raniganj field are not likely to receive attention at present.

The sedimentary iron-ores in the Tertiary formations are found in several places in Assam, in Darjeeling, Naini Tal and Almora districts.

Large deposits of laterites occur in many parts of the country, particularly in Madhya Pradesh, Bombay and Madras Since better grades of iron-ore are easily accessible in many parts of the country, the laterites are not receiving attention

In Singhbhum district the iron-ore is mined in Kolhan where the important places are Pansira Buru, Gua, Buda Buru and Noamundi all in Kolhan estate The iron contents of the ores in this area are greater than those of Mayurbhanj In Mayurbhanj the important places are Gurumahisani, Sulaipat and Badampahar They contain large deposits of high grade iron ore

The Indian Iron Steel Co Ltd , with their works at Burnpur and Kulti and Tata Iron & Steel Co Ltd , with their works at Jamshedpur, are the most important users of Indian iron-ore The Indian Iron & Steel Co., Ltd , take their ore from the mines situated at Gua in Kolhan A branch line of the Eastern Rly carries all the ore from these mines

The Tata Iron & Steel Co also possesses rich ores in Kolhan and in Keonjhar. Keonjhar possesses two fields one in the Baiga Buru ridge and the other at the north-eastern part which is really a continuation of Noamandi mine of Singhbhum But prior to 1926 when Noamandi iron mine in Kolhan was opened, practically the whole of the supplies of iron-ore for the Tata came from their deposits in Mayurbhanj, which are nearest to the site of the work and to which the Railway runs a branch line, about 56 miles in length The three most important deposits

of Mayurbhanj are —

(1) Gurumahisani (Gurumaishini) ;

(2) Okampad (Sulaipat), and

(3) Badampahar The ores here are of the same type as those of Singhbhum and Orissa

(1) The Gurumahisani hill mass, with its three prominent peaks and its numerous flanks and spurs, forms a conspicuous feature of the northern part of Mayurbhanj. On the north side, the lower slopes of the hill have now been worked out and practically no ore remains below a height of about 400 feet above the plain level, but south of the main peak the ore is still unworked down to the foot of the hill. The average iron content of the Gurumahisani ore is 63 p c

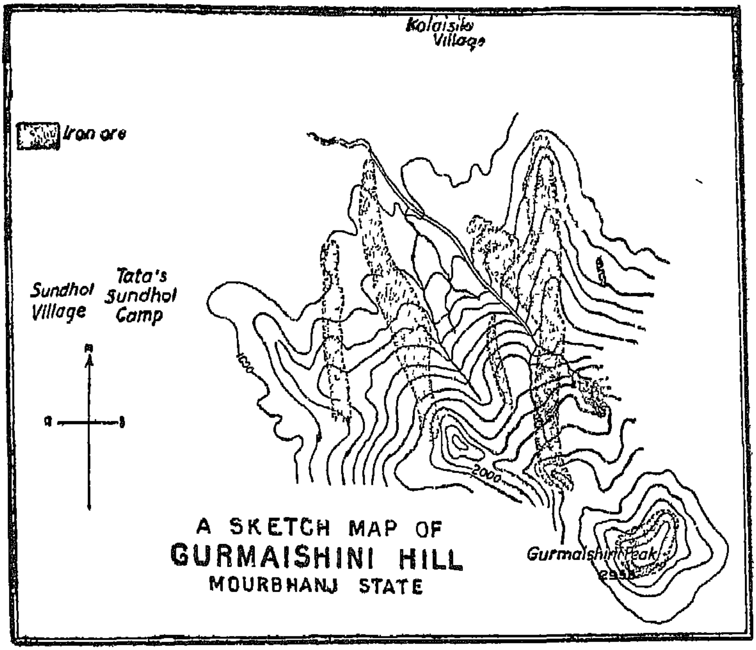


Fig 40

(2) The Okampad (Syaipat) ore deposit is situated just west of the Khorkai river Sulaipat ore is richer than Gurumahisani ore it has about 67% metal content The main ore body occurs on the top of the hill.

(3) The Badampahar ore deposit is neither so large nor so rich in iron as the ores of Sulaipat and Gurumahisani It is,

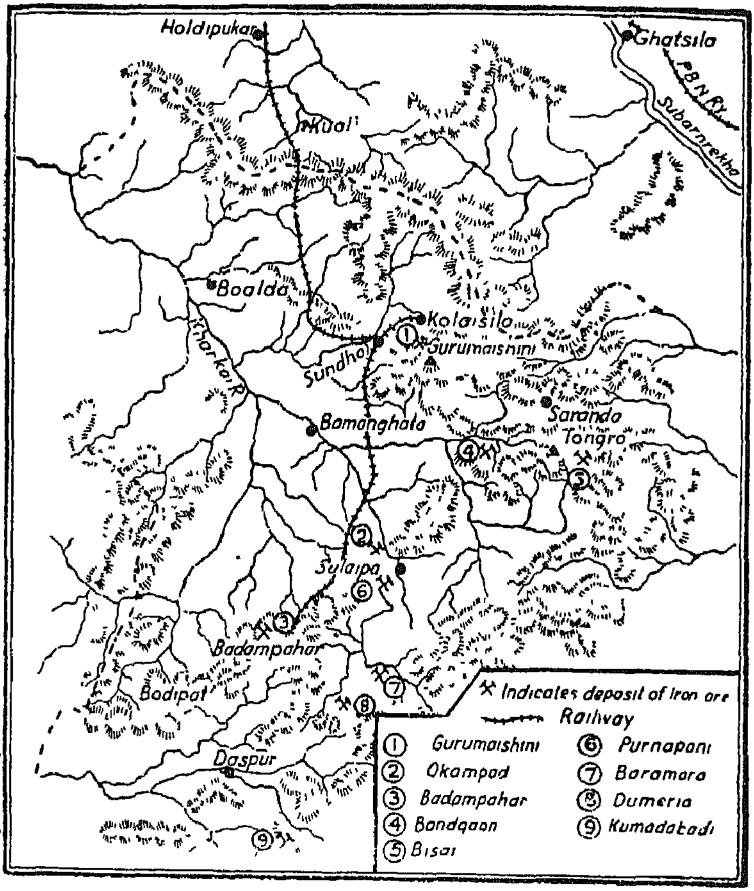


Fig 41 Showing Important Iron Mines

however, more porous and is highly valued on that account in spite of the lower iron content (56 to 58 p c)

The Tata Company's Noamundi Iron Mine is in Kolhan The ore occurs in thick bedded deposits of haematite, averaging well over 60 p c iron The ore is found on two main parallel ridges rising to a maximum height of about 1,000 ft. above the railway level The ore at the surface is either hard, massive or laminated Below 100 feet in depth it appears to be largely powdery ore at quite shallow depths

The Indian Iron Co also draws its iron supplies now from Kolhan The principal deposits are known as Pansira Buru and Buda Buru near Manharpur station of the E Ry. The total quantity of the ore in Pansira Buru has been estimated at 10 million tons, that is, more than that of Gurumahisani; whilst the estimates for Buda Buru are tremendous, about 150 million tons. The ore is generally a high grade haematite with an average content of 64 p. c. iron.

In Mysore, the haematite ores of the Bababudan hills are the most abundant and are of good quality, but they vary considerably in their metal content and the amount of phosphorus they contain The main source of the ore supply for the Bhadravati Iron Works of Mysore is the Kemmangundi ore-field, about 26 miles south of Bhadravati The average analysis of the high-grade ore gives 64% iron, but medium and low-grade ores vary from 53 to 58 p c iron The reserves are estimated at 25 to 60 million tons

Rich ores occur in Madhya Pradesh and Madras, they are worked very little, being far away from coal In the Drug district of Madhya Pradesh the ores, on account of their resistance to weathering agents, stand up as conspicuous hillocks in the general plain The most remarkable is the ridge which includes the Dhali and Rajhara hills extending for about 20 miles in a zigzag line, and rising to about 400 feet above the general level of the flat country around In places thick masses of comparatively pure haematite are found One such place is the Rajhara hill It is estimated that about 7½ milion tons of ore, carrying about 67 5 p c. of iron are found here The quantity estimated is for the ore that is visible on the surface There may be more in the depths not yet proved.

In the Chanda District of Maharashtra the iron ore forms a hill three-eigths of a mile in length, 600 feet in breadth and 120 feet high This hill is called the Lohara hill. The average Lohara ore contains 61 to 67 p. c iron

The ore found in Bellary (Mysore) and Kurnool, Cuddapah and Chittor districts (in Andhra Pradesh) is different in kind from the ore found in Orissa or M.P This ore is magnetite The principal occurrences are those of (1) Godamalai, (2) Thalamalai-Kolimalai, (3) Singapati, (4) Thirtamalai, and (5) Kanjamalai The total quantity of ore here is considered to be 'practically inexhaustible.'[1] The scarcity of fuel, however, makes it impossible to work these ores on a large scale. The quantity

of ore has been estimated at 304 million tons at Salem-Trichinopoly, 3 million tons at Kurnool and 130 million tons at Sandur.

Recently two large deposits of iron-ore containing an estimated reserve of nearly 389 million tons of ore have been located in Andhra Pradesh The deposits which are available in the Guntur and Nellore districts will last some centuries Of the total deposits, nearly 296 million tons contain 33 to 37% of total iron in the stock. The remaining are of a lower grade with only 25 per cent.

The Geological Survey of India have also discovered a new iron-ore field in the former PEPSU State Here the iron belt stretches to a distance of 2½ miles running from Mahendragarh to Chappia, Antari and Biharipur in the north-south direction. This area is expected to contain 20 lakh tons of iron ore. The G S I. is also of the view that in Dhanora-Dhancholi area of Rajasthan the same quality of ore is expected to be available Though this ore is suitable for steel making, yet it is not sufficient in quantity to run an iron steel industry of a substantial size

According to the recent investigations, of the iron-ore occurrences in parts of Guntur District, by the G S.I. some valuable deposits of iron-ore are found in Andhra In the Ongole group are included four deposits, namely, the Ongole beds, Konijedu-Marlapadu beds, Pernamitta beds and Sanampadi beds. The first three deposits lie in Ongole taluka (Guntur District) and the last deposit lies in Kandukur taluka (Nellore District).

The reserves of iron ore estimated in the Ongole group are given as below —

1	Ongole beds .	55,000 tons
2	Konijedu-Marlapadu beds. (South of eastern portion)	27,87,84,000 ,,
3.	Pernamitta beds . .	1,28,90,000 ,,
4	Sanampadi beds .. .	9,90,000 ,,
	Total .	29,21,79,000 tons

The magnetite quartz rock contains about 40 to 50 per cent silica and 33 to 37 per cent total iron-ore The ore is not suitble for direct smelting but is amenable to benefication.

1 *Brochure on iron ores*, Imperial Mineral Resources Bureau

Other new finds have been located in Chabali in Andhra, Pagadalapalle, Rajampet, Pendlimarri and Mantapampalli (in Cuddaph district) The reserves of 30,000 tons have been estimated

India produced 5,61,000,000 tons of Iron ore in 1961 as against 388 lakh tons in 1955 and 37 lakh tons in 1951.

RESERVES OF IRON ORE

India has got good reserves of iron-ore in the world. From the qualitative point of view, with an iron content ranging up to 68% or more they occupy a very high position in the world Apart from this high metal percentage, these ores are also notable for their lower sulphur content which never rises above 0 6 per cent Both in quality and quantity these ores are regarded as superior even to the great American occurrences of Minnesota, Wisconsin and Michigan The ores in the iron-belt of Bihar and Orissa are estimated to be sufficient for a thousand years with a pig iron output of 15 lakh tons annually.

The table, as under giving the estimated potential ore reserves in different countries, will be found interesting. It shows how the resources of India are considerable[1] —

Country	Million Metric Tons	% of Iron content
Algeria	44	50
Brazil	10,807	55
Cuba	5,400	36
Canada	7,000	50
China	1,215	45
Fr West Africa	2,600	47
France	3,876	37
India	10,272	51
Germany	840	30
Sweden	1,600	64
Spain	650	35
U S A.	25,488	36
U. K.	918	27
Venezuela	940	51

1 U N O. *World Iron Ore Resources*, 1952

According to Dr. Fox the reserves of different types of ore in India are as follows .—

Iron content	Reserve in m. tons
60%	3,341
45 6%	3 000
Less than 45.6%	1,500
Total ..	7,841 m tons

The following table shows the reserves of iron ore in India, having the metallic content of 60 per cent and over .—

Region	Estimate of G S I (In million tons)	Probable
I *Haematite ore .*		
1. *Bihar Orissa :*		
Singhbhum .	1,047	
Keonjhar . .	988	
Bonai ..	648	
Mayurbhanj ..	170	
	2,700	8,000
2. *Madhya Pradesh*		
Lohara .. .	20	
Pipalgaon	3	
Akola-Divalgaon ..	2	
Dalli-Rajhara Hills	120	
Bailadila . ..	610	
Rao Ghat	740	
Jabalpur .. .	550	
	1,550	3,000
3. *Bombay*		
Gua-Ratnagiri . .	7	
4. *Andhra*	43	
5. *Mysore* .	120	
6. *Sandur* . ..	130	
Total Haematite ore	4,550	12,250

Region		Estimate of G. S I. (In million tons)	Probable
II. Magnetite .			
Madras-Andhra-Mysore	..	435	
Bihar-Orissa ..	..		
Singhbhum-Mayurbhanj	.	2	
Palamau .	..	1	
Punjab ..		25	
Total Magnetite ore	..	463	1,200
III. Limonitic Spathic ores :			
Raniganj Coalfield	.		500

Iron ore is exported specially to Japan, U. S A. and U.K. The following table gives the export figures :—

Export of Iron Ore

Year			Quantity (000 Tons)	Value (Lakh of Rs.)
1950-51	..	..	85	22
1951-52	.	..	280	100
1952-53			811	371
1953-54	..	.	1 262	579
1954-55		..	1,009	421
1955-56	..	.	1,363	627
1956-57	..	..	1,982	1,030
1957 58	..	.	2,216	1,186
1959-60		..	..	1,460
1960-61	..		.	1,700
1961-62	..		..	1,740

Manganese

The occurrence of manganese is widespread all over the Peninsula. India's position in respect of manganese production in the world is second only to that of Russia[1] Our ores, which

1 The chief manganese-producing countries (in 000 metric tons)

			1935	1950	1954
India	...	...	313	425	897 (1953)
S Africa		...	48	332	286
Gold Coast		. .	228	376	242
U S A.	.	. .	13	70	91
Japan	. .	...	17	56	67
Brazil	.		29	86	42
Italy	.	...	3	5	14
Total World		...	750	1,720	2,550

average 50 p. c or more, are richer in manganese content than the Russian ores whose average is about 45%; Gold Coast, 41 to 50%, and Brazil 23 to 50% The prosperity of manganese mining is closely related to the production of steel, because the main use of the manganese-ore is in that industry. India is not a large producer of steel and the manganese miner in India, therefore, has to look to the steel producer of Europe or America In 1958, the production of ore was estimated at 12,11,000 tons. Of this production Orissa contributed 355,000 tons, Bombay 306,000 tons, and Mysore 236,000 tons In 1960 and 1961 the production of manganese-ore was 11,99,000 and 12,30,000 tons respectively.

The manganese deposits are in different parts of the Deccan as they are often associated with rocks of Dharwar age The most important ones are :—

(1) In Madhya Pradesh—Seoni, Balaghat, Jabalpur, Chhindwara and Jhabua districts

(2) In Bombay state—Panch Mahals, Chhota Udaipur, North Kanara, Ratnagiri, Bhandara, and Nagpur.

(3) In Mysore—Chitaldrug, Kadur, Shimoga, Tumkur, Bellary and Belgaum.

(4) In Madras—Sandur State.

(5) In Andhra—Vishakhapatnam.

(6) In Orissa—Gangpur and Keonjhar.

(7) In Bihar—Singhbhum (Chaibasa).

Besides these areas, manganese-ore also occurs mixed with the laterite.

In M. P the Balaghat deposit is $1\frac{3}{4}$ miles in length while the Manegaon deposit attains a length of $1\frac{1}{2}$ miles. The deposit extending through Jamrapani, Thirori and Ponia in the Balaghat district is known to run more or less continuously for a length of 6 miles According to Dr. Fermor, these deposits are 45 to 50 ft. in thickness.

The reserves of manganese are by far the largest in the world The total is estimated at 1,000 million tons of ferro-grade ore and 200 million tons of ore of lower grade as will be clear from the following figures :—

Known Manganese of the World
(in million short tons)

	High Grade (Average 45%)	Low Grade (Average 25%)
India	1,000	200
Union of S Africa ..	50	..
French Morocco ..	30	20
Belgian Congo ..	10	20
Ghana (Gold Coast) .	10	20
Brazil ..	50	.
Cuba ..	4	8
Other Areas ..	16	27

The figures of manganese reserves stand as under Madhya Pradesh, 100,000,000 tons; Madras, Mysore 2,500,000 tons; Orissa, 100,000 tons and Bombay 5,000,000 tons

The iron ores and the manganese ores are similar There are some ores in which the proportion of manganese is considerable. These ores are called manganiferous iron-ores The dividing-line between the manganiferous iron-ores and the manganese ores is now taken at 40 p c manganese content In the U S A. this limit is at 35 p c only Ores with less than 5 p c manganese content are called iron-ores

India's proportion of world production of the manganese has varied from time to time owing to the appearance of new producers.

Most of the exports go to Great Britain Other countries taking our manganese-ore are France, Japan, Belgium and Germany. During 1961-62 we exported 1040 lakh rupees worth manganese ore as against 1400 lakh in 1960-61 through Vishakhapatnam, Bombay and Calcutta ports

There is a steady consumption of the manganese-ore at the works of the three principal iron and steel companies, not only for use in the steel furnaces and for the manufacture of ferro-manganese, but also for addition to the blast furnace charge in the manufacture of pig iron

Manganese ore is a true "Jack of all-trades" among industrial materials It is used in porcelain enamel, dry batteries, building brick, glazed pottery, plastics, colouring and decolouring glass, disinfectants, welding rod, chemicals, varnish and floor tile The steel industry is, however, the largest consumer, taking more than 90 p c of the world output

MICA

Mica is a group name for several minerals which, though differing in chemical composition and physical properties, are characterised by their ability to split readily into very thin plates or flakes which are more or less tough, elastic and transparent according to variety Only the three following varieties are known commercially as mica :—

(1) Muscovite (white mica)

(2) Phlogopite (amber mica)

(3) Biotite (black mica)

Muscovite is the most important mica of commerce, phlogopite coming next to it, but biotite is practically of no value.

The chief mica-mining areas in India are those of Hazaribagh in Bihar and Nellore in Andhra Mica has also been obtained from workings in the Eranial taluk of Kerala, the Hassan district of Mysore and Ajmer and Udaipur districts in Rajasthan.

The 'Mica Belt' of Bihar obliquely traverses the districts of Gaya, Hazaribagh and Monghyr, along a strip about 12 miles broad and over 60 miles long A large number of the more important workings are situated either in or near, Kodarma forest especially at Kodarma, Domchanch, Giridh, Chakal, Dhaw etc. By far the larger proportion of the Indian output of mica is obtained from the Bihar Mica Belt, although the mica is often commercially spoken of as 'Bengal Mica' All this mica is sent to Calcutta whence it is exported.

The mica mines of the Nellore district of Andhra are situated on the eastern half of the Andhra coastal plain over a tract of country some 60 miles long and 10 miles broad Andhra mica has a characteristically green colour Most of the mines are situated in Rapur taluka Here mica is raised by open quarrying at Gudar, Kacali, Atmakur and Rapur

In 1957 total exports of mica were 22 376 metric tons, valued at Rs 8,66,36,000 In 1958 the exports declined to 19,735 metric tons, but valued at Rs 93,449,000.

Workable deposits of mica have been located in Orissa in the districts of Ganjam, Koraput, Cuttack and Sambalpur, in Rajasthan in Udaipur (Bhilwara, Shahpura, Tonk, Raipur, Rajnagar), Ajmer, Jaipur districts; in Punalur and Nayyoor in Kerala

Mica both in Bihar and Andhra occurs in pegmatites. The pegmatite veins are generally lenticular in shape and many have a maximum length of 1,500 ft. with a maximum thickness of 100 ft Mica occurs in rough crystals called 'blocks' or books, those measuring 15 ft. in length and 10 ft. in thickness are known to occur. It has been found that mica represents about 6% of the total rock excavated, while mica of saleable quality after dressing represents only 1 per cent. The value of mica depends upon the size of books, perfection of cleavage, colour and clearness

Mica is used in a large number of industries, in medicinal preparations and for decorative and ornamental purposes. It is now regarded as one of the chief strategic minerals. It enjoys certain special qualities like transparency, breakability into thin films, flexibility, elasticity and resistance to heat. Hence, it is used in making lamp chimneys, fronts of stoves, furnaces, protective spectacles, fire-proof points, patent roofing materials, in wireless telegraphy, radio communication, aeronautical engineering and motor transport. Ground mica is used as a lubricant.

However, the chief use of mica is for electrical purposes as an insulator Formerly only larger sizes of mica were in use, but during the war smaller sizes also became marketable. This is largely due to the development of the micanite industry. Micanite is really the built-up sheets of the smallest and thinnest films of mica which are cemented together with shellac dissolved in spirit The micanite sheets can be built to any size and thickness. They require to be steamed, pressed and rolled, and then can be moulded to any desired shape. India has practically a monopoly of mica and shellac used in making micanite. And yet micanite is not manufactured in India for want of industrial development, especially that of electrical industry.

Practically the whole of the mica produced here is exported to Great Britain, United States, Germany and France.

The exports mainly go through Calcutta, Madras, Vishakhapatnam and Bombay. The following table gives the mica exports from India —

1948-49	Valued at Rs.	593 lakhs
1950-51	„	1,000 „
1951-52	„	1,321 „
1952-53	„	901 „
1953-54	„	800 „

1954-55	Valued at Rs	672	lakhs
1955-56	,,	837	,,
1959 60	,,	1,000	,,
1960-61	,,	1,020	,,
1961-62	,,	970	,,

The financial turnover of the mica industry is small compared to major industries of India It is concentrated in four or five districts in India, in Hazaribagh, Gaya and Monghyr in Bihar, in Nellore and in Rajasthan In Bihar is concentrated the main source of *muscovite mica,* so indispensable for electrical, auto and aero industry and which is the only raw material which was carried by air from India at a cost of about Rs 4,000 per maund during the First World War

The workers employed in mining and manufacturing of mica exceed over two lakhs all over India of which one lakh and a half are concentrated in Bihar alone. The quality of mica mined from Bihar as well as the unrivalled skill of the Bihar workers have placed the mica industry on a semi-monopolistic basis in the world Although deposits in South Africa, Brazil, Canada and Russia have sought to undermine its position, yet predominance of the Indian mica industry is beyond question even now

In 1957 the production of mica amounted to 6,09,000 cwts. (30,943 metric tons) valued at Rs 231 5 lakhs In 1957 Bihar, Rajasthan and Andhra produced 345,762 cwts, 147,037 cwts ; and 101,777 cwts respectively In 1958 there was an upward trend in the production of mica—31 811 metric tons, in 1959 there was a fall of 3,117 metric tons *i.e.* the production was 28,694 metric tons but in 1960 again the production rose to 29 226 tonnes which was valued at Rs 247 lakhs, but in 1961 it again fell down to 28,347 tonnes and was valued at Rs 23,658 lakhs

Copper deposits occur, generally, as lodes of copper sulphides with associated secondary carbonates and also as disseminations The minerals are in the form of Sulphides (like chalcopyrite, chalkociye, bornite and terrahedrite) and carbonates (like azurite and smalchite) etc In India copper is mined in the form of *chalcopyrite.*

There are evidences of copper having been mined in India in the past over a very large part In the Singhbhum district of Bihar a copper bearing belt, marked out by old workings, persists for about 90 miles, extending from Duarparam on the Bajhmini river in an easterly direction through Kharsawan and

Saraikela into Dhalbhum, where it curves round to south-east, running through Rajdoha and Matigara to Bhairagota. The important portion of this belt occurs between Rajdah and Badia. The copper ores in India occur as indefinite lodes inter-bedded with other rocks. Sometimes the ore is collected into fairly well-defined bands, but very frequently it occurs in the form of grains so sparsely distributed through a considerable thickness of hard rocks as to be unworkable When concentrated into definite lodes, as at Matigara or Mosaboni, the ore may be of high grade

The most important copper works in India belong to the Indian Copper Corporation at Maubhandar, Ghatsila This company converts into brass sheets with the help of zinc any copper that it cannot sell as ingots in India.

Two parallel ore deposits have been developed in the Mosaboni mine The grade of ore here varies from 2 5 to 3 p c. of copper There is also a little production of Dhobani where a deposit parallel to that at Mosaboni is being opened up The proved resources of copper ore of Singhbhum district are estimated at 3 3 million tons Here the ores are primarily chalcopyrite and secondary carbonates

Other important regions where occurrence of copper ore has recently been reported are Sikkim, Garhwal, Rajasthan and Andhra Pradesh.

Best known deposit in Sikkim is Bhotang near Rangpo. At the Bhotang mine there is a load of 10′ to 15′ thick containing ore on an average tenor of 3 to 4 per cent copper Here several other prospective regions occur, *e.g.* Dikchu, Rohtak, Sirbong, Sisni, Jugdum, etc At Dikchu the load is 3 ft in width and is traceable for 300 ft It contains 6 14% of copper

In U P. in Garhwal district there are workings at Dhan pur and Pokhri but little information is available about the reserves as no prospecting has been done so far

In Rajasthan copper minerals are found in irregular veins and stringers in highly deformed phylites in Khoh-Dariba area (in Alwar). This zone is roughly 600 ft in length, average width of 30′ extending to a depth of 150′ from surface Here there are found extensive old workings There is another mineralised zone of over 15 miles in length in Khetri area (in Jaipur), ore occurring in slates and schists

In Andhra, there are two prospective areas They are Agnigundal (9 miles north of Vinukon in Guntur Distt), and Gani (in the Kurnool Distt.) No systematic survey has yet been carried out so far.

The production of copper—ore and refined copper in India is given in the following table:—

Year	Copper ore	Refined copper
1956	385, 196 tons	7628 tons
1957	403,929 tons	7848 tons
1958	411,000 metric tons	7966 metric tons
1959 (January to November)	373,000 metric tons	7465 metric tons

In 1960 the production of copper-ore was 4 5 lakh tons valued at Rs. 237 4 lakhs and in 1961 the production was 4.2 lakh tons valued at Rs 22981 lakhs.

India is not fortunately placed as regards the copper ore deposits since only one unit is producing copper in India The annual production of copper is about 7,200 tons per annum while the country's demand has been estimated between 25 to 30 thousand tons per annum distributed as: 12 to 15 thousand tons for electrical cable and wire, 8 thousand tons for utensils and hollow wire industry and 5 to 7 thousand tons for defence, railways, and other miscellaneous requirements. Therefore, there is a very wide gap to be filled up

Hence we import large quantities of copper from U S A, Canada, Rhodesia, Japan and Portuguese East Africa This imported copper is used for high electrolytic materials, while the indigenous production is used in the manufacture of brass for utensil industry and other copper base alloys.

The imports of the copper metal for the last some years are as follows:—

Year	Quantity (000 cwts)	Value in Rs. crores
1954-55	540	8 7
1955-56	362	8 7
1956-57	701	16 1
1958	52336*	134272

[1]In '000 metric tons

BAUXITE

Out of the family of non-ferrous metals aluminium is the only metal which has extensive ore deposits in the country

1. The former class includes bauxites of Spain, France, Italy, Yugoslavia and Roumania. These ores seldom contain more than 14 per cent of combined water

While the bauxites of America, Africa, India and Australia belong to the latter class, they contain 22 to 30 per cent of combined water.

According to Dr. Fox there are two main classes of ores: (i) The Mediterranean type and the (ii) Indian type.[1] Commercial deposits of bauxite in India is the residual production of rock-weathering as well as by alteration of granite-gneiss, Vindhyan limestone and Vindhyan sandstone

In India there are four well-marked belts of bauxite deposits The first belt is connected with the Deccan Trap region of the Peninsular India

(a) In this belt the most important deposits of bauxite occur in Bombay in Kolhapur and Halar district in Saurashtra In Kolhapur it occurs in Dhangarwadi hill The reserves are estimated at 8-10 million tons Bauxite also occurs in Kapadvanj in the Khaira District, in Thana District and in Satara, Surat, Poona and Ratnagiri District besides Bhir, Rajpipla and Baroda

(b) In Madras the important deposits are situated in Shevaroy hills in the Salem District The total reserves of all grades of bauxite in this region are estimated at 7 million tons while the grade suitable for manufacture of aluminium are estimated at 2 million tons

(c) In Mysore minor deposits of bauxite occur in Bababudan Hills The bauxite deposits of Belgaum are estimated to contain about 7 lakh tons

(ii) The second belt is represented by the region of numerous detached plateux formed of the gneiss near Lohardaga in the Ranchi and Palamau Districts of Bihar. The reserves of high grade ore are estimated at about 10 million tons

Although some bauxite deposits occur in Korla Pat in Kalahandi and Sambalpur districts of Orissa State, the total reserves of quality suitable for aluminium manufacture are estimated at less than 4 lakh tons According to Dr Krishnan, a band of yellow-coloured bauxite of good quality having a vertical thickness of 15 ft and a horizontal extent of 450 to 500 ft occurs in laterite on the western flank of the Korlapat Hill

(iii) The third belt is constituted by the group of bauxite deposits derived from the Vindhyan rocks in the neighbourhood of Katni Next to Bihar, Madhya Pradesh contains the most extensive deposits of bauxite in Surguja, Raigarh and Bilaspur region, Balaghat and Katni areas in Jabalpur District. The total reserves of bauxite of grades suitable for manufacture of aluminium metal in this State are estimated at about 7 million tons.

(iv) The fourth belt is represented by the disaporic deposits occurring in Kashmir in Poonch and Riasi areas. These deposits are diasporic in nature and are very refractory and not easily soluble in caustic soda The reserves are estimated at a million tons

Our total known reserves of bauxite are estimated at 250 million tons of all grades Of this high grade reserves would amount to 35 million tons distributed as Madhya Pradesh, 15 10 million tons, Eastern States, 8 58 million tons, Bihar 5 23 million tons, Bombay 3 23 million tons; Madras, 2 00 million tons and Kashmir 1 00 milion tons Even at this estimate the aluminium industry with a capacity of 50,000 tons per annum can be assured of a supply for at least 150 years These bauxite deposits, besides being large and of high quality, are also fairly evenly distributed Looking to the geological strata in the different parts of the country, there is also a great possibility of more bauxite deposits being found and proved.

Table showing production, consumption, and exports of Indian bauxite

Year	Production	Export	Available for consumption	Actual consumption by the aluminium industry	Actual consumption by the Cement industry	Quantity available for other uses
1948	22156	535	21621		.	..
1951	67047	808	66239	18538	6331	41370
1956	91225	4405	92092	45199	17125	29768
1957	96750	8490	116358	53844	19555	19212
1958	136907	20519	191369	66127	15839	46675
1959	217,991	23189	88260	49493	14325	110944

Some useful information regarding production, consumption and exports of Indian bauxite is given in the table It shows that the annual production of bauxite for 1959 was an all time record—214558 tons The pattern of consumption shown in the table above is very different from the nature of utilisation of bauxite in U.S A and other industrial countries There 90% of the output is consumed by the aluminium industry But in our country it is not so However the requirements of our aluminium industry have been constantly rising and it is expected that the consumption will increase considerably within a few years

There are two concerns which are producing aluminium in the country and their present installed capacity is about 7,500 tons per annum As against this installed capacity, the quantum of demand for aluminium in all forms has been steadily rising

The current requirement of India in regard to aluminium in various forms is estimated at about 25,000 tons per year, and by the end of 1963 it will be 35 to 40 thousand tons Thus, a wide gap has to be filled up The production of this mineral in the year 1959 was 217,991 tons valued at Rs 2,212,000. which had been achieved in 1960 because the production of bauxite in that year was 387380 metric tons In 1961 the production of bauxite was 47600 tonnes which was valued at Rs 46.8 lakhs

The important ore of lead is *Galena* (sulphide of lead) which contains about 86% of the metallic lead Other lead ores are cerrusite (which is carbonate of lead) which contains about 77% of the metallic content and Angesite (the sulphate of lead) in which the metal content is 68%

Although a number of occurrences of lead have been reported as scattered in places like Hazaribagh in Bihar, Gwalior, Datia and Drug in Madhya Pradesh, Udaipur and Jaipur in Rajasthan, the only commercially workable deposits are in the Zawai mines near Udaipur in Rajasthan These deposits are worked by M/s Metal Corporation of India, Ltd, who are separating the lead concentrate from the mixed ore The statistics reveal that the possible reserves are about 400,000 tons of combined metallic zinc and lead forms an equivalent of about 10 million tons of ore of all grades (12 to 13 per cent) The smelting and conversion are carried out at Tundoo in Bihar The present position of production of lead concentrates in the country is about 5,532 tonnes in 1961 worth Rs 1,691,000

In India 162000 metric tons of lead-zinc ores were produced during 1959 It was nearly 38% higher than the production in 1958 which amounted to 3387 metric tonnes

The recovery of lead concentrates was to the tune of 5341 metric tons in 1958, 6488 metric tons in 1959, 6245 tonnes in 1960 and 5532 tonnes in 1961

The production of refined lead during 1959 was 3958 metric tons as against 3387 metric tons in 1958, representing an increase of 17%.

The import of lead ore and concentrates into India were 104 and 112 metric tons in 1957 and 1958 respectively. They valued at Rs. 334000 in 1957 and Rs 192000 in 1958. Lead metal was imported to the quantity of 14766 and 21844 metric tons in 1957 and 1958 respectively

"As a metal, an alloying agent, an ingredient of manufactured goods, and an agent in industrial operations, the range of lead's usefulness is about as wide as the field of industry itself It is present in the paint, plumping materials, glass-ware and musical instruments, in the office it is used in type-writers and calculating machines, in transportation large quantities are required in the manufacture of automobiles, airplanes, locomotives, batteries, and electric wires It is valuable in the building trade, communication by wire, the printing industry, the sportsman's rifle and the chemical laboratory In a word, after iron, it is the most commonly used mineral due to its lightness, softness and maleability It is a bad conductor of heat"

ZINC

Zinc is a mixed ore containing lead and zinc Its chief ore is zincsulphide. But it is also obtained from calemine, zincite, wilemite and hemi-morphite

In India the known resources of zinc ore are rather limited as there is only one commercially exploitable deposit in Zawar near Udaipur in Rajasthan. It is being worked by M/s Metal Corporation of India Ltd. No zinc is being produced in the country at present and the zinc concentrates containing about 50 to 54 per cent zinc is of the order of 5,800 tons The Corporation is now installing more equipment in the ore-dressing plant, and it is expected that they will be able to treat in their milling plant 500 tons of ore per day The production of zinc concentrates during 1961 was 9,254 tonnes.

In 1958 and 1959 the production of zinc concentrates was 7391 and 9978 metric tons respectively, showing a substantial rise in production in 1959 But in 1960 there was a slight fall as the production fell to 9787 tonnes There was further fall in 9254 tonnes

As there is no production of zinc in the country all the requirements of the nation are met by imports. The imports of zinc metal in 1957 and 1958 amounted to 54257 (valued at Rs 72425000) and 60655 (valued at Rs 6130400) metric tons respectively.

Zinc is imported from Rhodesia, Australia, U S.A and Holland.

Our present demand for zinc is of the order of about 40,000 tons a year and this demand is expected to rise to 50,000 tons by the end of 1963-64 as more zinc will be required for galvanizing larger production of steel sheets.

The Zinc Committee has, therefore, reported that India should have proved reserves of ores to mine continuously up to the extent of 1,000 tons per day for a reasonable number of years in order to be able to establish and feed smelter of an economic size M/s Metal Corporation of India, Ltd, are implementing their programme to develop these mines so as to raise 1,000 tons of ore a day which will be sufficient to feed a zinc refinery of 10 to 12 thousand tons per annum

TIN

Tin ore occurs in the mineral Casseterite found in granitic rocks and occurrences were noted in Hazaribagh, Gaya and Ranchi districts in Bihar Pits were sunk, several decades ago, at Narungo to a depth of 600 ft but the tin values are stated to have decreased with depth and the deposits were not considered an economic proposition Small amounts of tin ore are found associated with Granite and Pegmatite at Chapatand. Seniratal and Chakkar-Bandha Some work was done a few years ago on this deposit but the operation were not profitable The deposits known so far have not yielded sufficiently encouraging results

It is very deficient in tin and, therefore, every year we have to import it from Malaya, Singapore and other countries. At present India consumes about 4,000 tons of tin and 12,000 tons of tin plate annually in the electrical goods industry, the metal container industry and the pharmaceutical industry

Our demand is expected to be about 7 thousand tons by 1963-64, due to increased production of tin plates and copper-tin base alloys

Tin is of great use and is very largely employed in a number of uses "It accompanies man in every walk of life literally from cradle to grave. It is a necessary ingredient of soldier, and is a component of habit and most other anti-friction metals, without which manufacture and transportation would be impossible As foil, it wraps like the work-man's tobacco and the school girl's confections It accounts for rustle and lustre of silk

so dear to feminine heart, while the tin dinner pail has a place in politics and is celebrated in song and story Without humble tin can the world could no longer be properly fed"

ANTIMONY

Antimony is a useful alloy for mixing with softer metals. In India antimony deposits are found in Lahul and Kangra district in the Punjab. A considerable quantity may also be obtained from the Chitaldrug district in Mysore. As no other workable deposits have so far been discovered, India has to import large quantities of these ores from abroad.

The installed capacity of the unit—Star Metal Refinery, Bombay—which is producing antimony is estimated at 1,000 tons per annum which is more than sufficient to meet the present demand estimated at about 600 tons By the end of 1963-64 as a result of increasing consumption the demand is expected to rise to 800 to 1,000 tons per annum.

SALT

Salt produced in India is obtained from two main sources: (i) sea water, and (ii) brine in the lakes of inland drainage, especially the Sambhar lake About two-thirds of the salt made in India is obtained from sea water, chiefly in Bombay and Madras, very little industrial use is made of Indian salt, as the production of salt in India consists of the so-called 'common salt' and not of industrial salts The only industrial salt produced in India is saltpetre coming from Bihar and U P In 1950 we produced 7,000 tons of saltpetre Nearly the whole of the quantity is exported to U.S A , U K ; Mauritius, Ceylon, Malaya & Indonesia. A small quantity is used in Assam tea gardens.

As the production of common salt has a great political significance for the people of India—the famous Dandi March of Mahatma Gandhi is a landmark in the history of Indian freedom. We give below a detailed account of the salt production in India.

Ideal conditions for salt-making are :—

(i) Proximity to the sea to have easy access to brine,

(ii) Scanty or no rainfall,

(iii) Strong insolation, which in turn depends on cloudless skies,

(iv) Moderate to strong winds,

(v) Moderate to high air temperature with large deficiencies of moisture,

(vi) Moderate to high evaporation which depends upon the foregoing factors.

From this point of view the following are suitable areas for salt-making in India:—

(i) The Saurashtra coast,

(ii) Southern half of the Coromondal Coast, between Naga patam and Cape Comorin,

(iii) North Andhra—Madras Coast between Nellor and Gopalpur,

(iv) The Sambhar Lake.

The table[1] below compares the climatic conditions found in the salt-making centres in the above areas.

	Annual Rain	No. of Rainy days	Mean Air Temp	Mean Humidity	Mean Evaporation
Dwarka	13 52"	20	78	75	98 12
Pamban	37"	30	82	75	88 40
Gopalpur	44 96"	60	80	75	89 58

The largest production of salt in India is from the western coast. Maharashtra State ranks first in salt production. Most of the salt in Maharashtra is made by the direct solar evaporation of sea water The factories at Dharsana, Bhoyandar, Bhandup Uran and Mithapur and Chharvada on the eastern side of the Gulf of Cambay near Bulsar and Okha in Saurashtra belong to the Government The other sea salt works are grouped within a radius of thirty miles of the city of Bombay Those which are owned by the Government are leased to private persons for working; while the others are owned and worked privately A site for a salt works is chosen generally below the level of high water in spring tides and surrounded by strong embankment Within this are situated the outer and inner reservoir and the 'pan' area The outer reservoir is filled when the tide is high, from it the water flows to the inner reservoir, and thence to the crystallising pans. The floors of the crystallising pans in Bombay, and elsewhere generally, have their floors levelled and stamped with clay which gives the muddy colour to salt

1 *Scientific Notes*, Met Deptt, India, Vol VI, 1935

After a few days when a layer of salt, about a quarter of an inch thick, has formed on the bed of pan, it is raked to the edges of the pan, washed, allowed to dry and then separated into different sizes The pan is filled again with water and the process repeated

The season of manufacture varies with the south-west monsoon, January to June being the normal period

A considerable proportion of the Bombay salt is Baragra of Rann salt, made from salt water derived from wells on the little Rann of Cutch The largest works at the Rann are at Kharagoda and Kuda There the salt water is obtained from circular wells about 9 feet in diameter and about 18 to 30 feet deep. Here the saline content of the water is very high The manufacturing season here lasts from November to April.

On the east coast, salt is manufactured in Madras and Andhra States from the district of Ganjam to Tuticorin to the extreme south The salt works are at Nanpada, Pennuguduru, Madras, Cuddalore, Adirampatnam and Tuticorin State much on the same lines as in Bombay The sea water is usually brought from tidal backwaters through channel, from which it is baled into condensing beds In some works the pans are irrigated several times before the layer of salt crystals is removed, but the 'single irrigation' system is the most common. The season of manufacture varies according as the salt works are subject to the south-west or the north-east monsoon In the northern districts, manufacture commences in January or February and continues till June or July, when the rains begin On the South, manufacture commences later, in March or April, and continues up to October or November. Madras salt is consumed locally, and some of it is exported to Ceylon Some is also sent to Orissa, West Bengal, Mysore, and Madhya Pradesh.

The whole of the desert region of Rajasthan is impregnated with salt from the coast of Cutch, north and north-eastwards to the borders of Delhi In this area there are many temporary or permanent salt lakes as for example, the *Sambhar* and *Didwana*, which are utilized for salt making; while in other places sub-soil salt water is raised, as at *Pachbadra*. Most of the salt in this region appears to be brought in as fine dust by the strong winds which blow from the south-west during summer These winds blow across the salt-incrusted Rann of Cutch, and carry away sea-spray and finely-powdered salt in large quantities into the heart of Rajasthan where it remains deposited until the monsoon brings enough rain to wash it into the small lakes in the areas of internal drainage.

The Sambhar is the largest of these salt lakes and covers an area of about 90 square miles at its highest level, but dwindles, generally, to a small puddle by March or April. The mud forming the bed of the lake contains an average about 5% of salt down to a depth of at least twelve feet. According to Christie there are more than 55 million tons of salt in the upper 12 feet of the silt When the lake dries up, salt water contained in its clay bed rises to the surface by capillary action and is evaporated there.

A big dam has been built across the lake near the Sambhar town, and water from the main lake is pumped into a reservoir thus formed From this reservoir it is transferred to smaller reservoirs and thence to evaporating pans. More than three-fourths of the Sambhar salt is consumed in U.P. and Rajasthan, Punjab, Delhi, and Madhya Pradesh

The largest production of salt in India is from the Sambhar Lake which yields about 10,000,000 mds. of salt annually.

The total area of salt pans in India amounts to 83,386 acres These pans produced about 3462000 tonnes valued at Rs. 76,11,80,000. The consumption of salt in India is mainly for human food. A small amount is also given to animals The use of salt for industrial purposes is negligible here owing to industrial backwardness That is why the per head consumption of salt here amounts to 8 lbs as compared to the world's average of 30 lbs. The following table shows the salt requirements in India :—

Table and other household purposes	2.07	m. tons
Livestock and other agricultural uses	0 03	,,
Fish curing	0.01	,,
Dairy products	0 01	,,
Hides and Leather	1 07	,,
Industrial uses	0 31	,,
	3 50	m tons

In 1959 the country became not only self-sufficient in salt but had an exportable surplus of over 200 lakh maunds.

The total number of labourers employed in salt industry in 1958 was 31046 out of which 3278 were employed in the public sector.

The Rock salt in India is now available only from the Mandi State in the Punjab The salt is quarried at two localities—Drang and Guma, which are 14 miles apart. The salt is of dark purplish colour and contains earthy impurities to an extent of about 25 per cent

The First Five-Year Plan envisaged a production of 837 lakh maunds (3.1 million tons) in 1955-56. This target was surpassed in 1953 when the production amounted to 861 lakh maunds (3.16 million tons). The Second Plan target had been kept at 1000 lakh maunds (3 7 million tons) which has already been surpassed in 1958 when the production of salt was 1125 lakh maunds (4.1 million tons).

Target of salt production for the Third Five-Year Plan has been proposed to be fixed at 150 million maunds.

The programme for the development of the salt industry in the private sector includes establishment of laboratories and model farms, improvement in brine supply channels, installation of plant and machinery. In the public sector, the rock salt mines at Mandi are to be developed on scientific lines by sinking shafts, as a result of which salt production will increase to 4 lakh mds. per annum as against 1,50,000 mds. at present

As there is surplus production of salt in India, it is exported to Nepal, Indonesia, Japan, Malaya and Maldives

The exports of salt during the last some years have been as follows:—

(in lakh maunds)

1955 ..	.. 66·78	1957 ..	. 119 40
1956 ..	.. 83 96	19 58 ..	.. 79 51

GOLD

India is very poor in precious ores. Silver is entirely absent, while only a small amount of gold occurs in a corner of the Deccan tableland Practically all the gold mined in India comes from the Kolar fields in Mysore. The quantity of gold produced increased from 9 ozs. in 1882 to 2.5 lakh ozs in 1943 and 2,20,522 ozs. in 1954. Total production of gold from existing mines reached 4868 kilograms valued at Rs 59,103, thousand in 1961 as against 4995 kgs. worth 56,674 thousand rupees in 1960. In the Kolar field there is a single vein or reef averaging only some four feet in thickness in which gold occurs for a distance of about five miles There are four mines in the state, *viz.*, Mysore, Nandydroog, Oregaum and Champion Reef. The deepest mines are Champion Reef and Oregaum which have each reached a depth of considerably over 9,000 feet measured vertically. This is the greatest depth of gold mine in the whole of the world. Owing to great depths the problem of ventilation is a serious one in these mines The temperature in the lowest workings range from 118° F 122° F. This depth is also responsible for

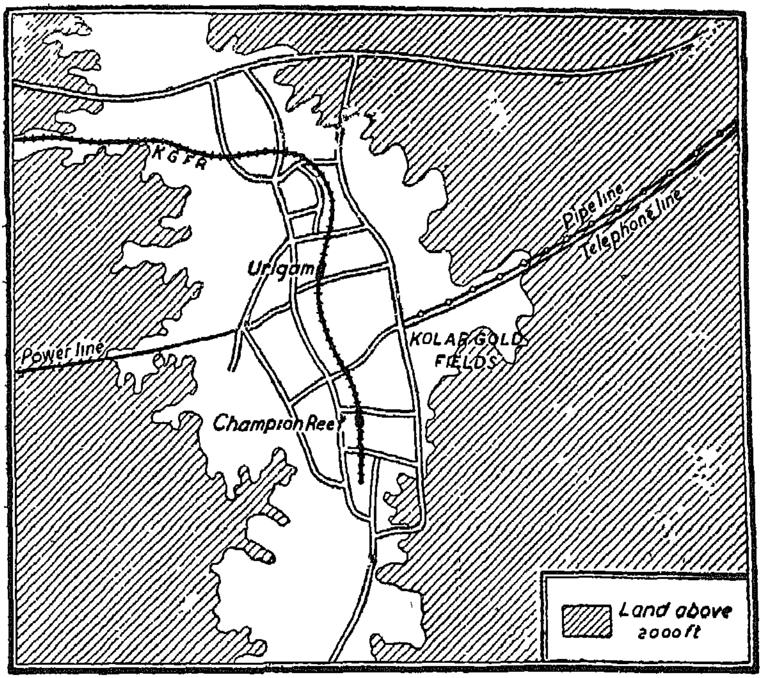


Fig. 42 Showing Gold Mines near Mysore

the large number of accidents that occur in the mines owing to rock bursts. The mines are supplied with electricity from Siva Samudram on the river Cauvery.

The only other working mine Hutti in Andhra—is of minor importance. Gold-bearing veins are also known to exist in Dharwar district of Mysore, Wynaad and Anantpur districts of Madras and Lava in Manbhum district of Bihar. These occurrences show signs of old workings.

Besides this gold vein, a little alluvial gold is also washed from the sand of the rivers of Assam and Orissa Some gold is also procured from alluvial soil of the rivers in Bijnor district of U.P , Ambala district in the Punjab and Singhbhum area of Orissa

Apart from the minerals and metals mentioned in the foregoing pages, large quantities of clay, limestone, bauxite and others are quarried in India

The Government is now giving greater attention to the mining industry in India. A Bureau of Mines has been established to achieve greater progress

QUESTIONS

1. Estimate the extent of India's iron-ore resources. What are the geographical drawbacks under which Indian iron-ore suffers at present?

2. Where is the manganese ore mined in India? What are the future prospects of manganese mining in India?

3. What is the extent of mica resources in India? Why is mica mining on a decline at present?

4. Where does India get its salt from? To what extent is the salt production in India dependent on climate?

5. What is the source of gold in India? What are the difficulties which the gold mining has to face here?

6. Suppose you have been appointed adviser to a big concern interested in manganese mining In what parts of India should it start operations? What other countries of the world are likely competitors against your firm in the supply of manganese? How do conditions of manganese mining and transport in India compare with those in foreign countries?

Chapter 9
Manufactures

India's economy centres round her agriculture which provides her people with food and the raw materials. Under ordinary circumstances Indians have been quite content to follow their forefathers' occupation—agriculture. Even the rudimentary manufacturing that has existed in the country for long, has been associated primarily with agriculture

The intimate contact with the English and the consequent growth of an urban population in India led to a rise in the standard of living of the people. Articles which were formerly considered luxuries became necessaries of life The demand for manufactured articles thus grew considerably. A very large section of the urban population became entirely cut off from agriculture The natural corollary of this separation from land was that, in due course of time, the city-dwellers started manufacturing enterprises on western lines The beginning of industrial enterprise in India were started first by the Europeans, but were later on, taken up by the Indians themselves. The first industrial magnates hailed from the two largest towns of India, Calcutta and Bombay, where the Western influences were most dominating

Industrial activity in India spread from the port towns of Bombay and Calcutta, not only because of the Western influences, but also because of the ease with which machinery and stores could be imported from Europe through these ports. These towns were already large business centres, and as such, supplied banking facilities so necessary for industrial enterprise

Another advantage enjoyed by these port towns for industrial enterprise was that most of the raw materials and other exports were accumulated there to be shipped abroad These facilities were fully taken advantage of by the new industrialists.

India is still backward in manufacturing industries The development of 'key industries', like the Iron and Steel and the Chemical industries, the products of which are essential for the general industrial development has not advanced far in India The main cause of this backwardness of the 'key industries' and the consequent backwardness of industries in general, is due largely to the defective distribution and poverty of coal resources of the country. Indian coal lies mostly in a remote corner

of the Peninsula where means of communication are deficient. Compared with this, the coal resources of the United States of America and England and of Germany lie in well-developed regions. The water communication provided by the rivers serving the coal region there has been of fundamental importance in developing the coal These communication facilities also helped in attracting manufacturing industries to it. The inferiority of the quality of the Indian coal has already been noted elsewhere in this book

THE INDUSTRIAL POLICY

During the first plan, considerable progress was made in the industrial sector. The index number of industrial production, which stood at 100 in 1951 rose to 103 6 in 1952; 105.6 in 1953; 112.9 in 1954; 122 1 in 1955, 133 0 in 1956, 137 2 in 1957 and to 141 0 in May 1958 A number of industrial projects have been completed in the public sector The Sindri Fertilizer factory (Sindri, Bihar), Chitranjan Locomotive factory (Chitranjan, Mihijham); Indian Telephone Industries (Duravaninagar near Bangalore). The Integral Coach factory (Perambur, Madras); the Cable factory (Rupnarainpur) and the Penincillin factory made good progress in production.

But few others like the Machine Tool factory (Jalahalli, Bangalore), Cement factory; (Nepanagar) and Bihar Superphosphate factory (Sindri) lagged behind the schedule.

The targets of production laid down in the First Plan have been exceeded in the case of cotton textiles, sugar and vegetable oils They have been attained more or less in the case of cement, paper, soda ash, caustic soda, and other chemicals, rayon, bicycles and certain other industries Short-falls have occurred in aluminium and nitrogenous fertilisers in the private sector and in light engineering industries such as diesel engines, pumps, radios, batteries, electric lamps, lanterns—the latter due mainly to lack of domestic demand

INDUSTRIAL DEVELOPMENT IN PLANS

During the First and Second Plans (1951-52 to 1960-61) there have been notable growth and diversification in Indian industry. The Second Plan period has been particularly remarkable in this respect The index of industrial production rose from 100 in 1950-51 to 194 in 1960-61. A number of industrial projects have been completed in the public sector Three new steel works, each of 10 lakh tons capacity, were completed and two existing steel works in the private sector doubled their capacity so as to bring their ingot capacity to 20 lakh and 10 lakh tons respectively, In the field of heavy engineering industry, the foundations were laid of heavy electrical and heavy machine

tools industries The production of machinery for cement and paper industries started for the first time. A number of new chemical products were manufactured such as urea, ammonium phosphate, penicillin, synthetic fibres, newsprint and dyestuffs and so on. There was a greatly increased output of the basic chemicals such as nitrogenous fertilizers, caustic soda, soda ash and sulphuric acid etc The output of such industries as bicycle, sewing machines, telephones, electrical goods, textile and sugar also increased.

Nevertheless, there have been some short-falls also The combined output of the new steel works was only 6 lakh tons in 1960-61 as against the target of 20 lakh tons The production of the Tata Iron and Steel Works was also below the mark. The expansion of the Government Sindri fertilizer factory and the three new fertilizer plants in the public sector at Nangal, Neyveli and Rourkela have all been delayed. The Heavy Electrical Project at Bhopal is also delayed.

Most of the other targets of capacity and production have been almost completed and in some cases the targets have been exceeded such as diesel engines, electric motors, electric fans, radio receivers and sugar etc

The actual expenditure in many projects has exceeded the estimates as laid down in the beginning of the Second Five Year Plan. The main reason was the lack of experience in project engineering

The Third Five Year Plan has laid greater emphasis on the establishment of basic capital and producer goods industries, with special emphasis on machine building programmes The Third Plan has laid down the following priorities for the development of industries in the country:—

(i) completion of incomplete Second Plan projects,

(ii) increased production of major basic raw materials and producer goods like aluminium, mineral oils, and dissolving pulp etc

(iii) increased production from domestic industries of commodities required to meet essential needs like essential drugs, paper, cloth, sugar etc

(iv) expansion and diversification of capacity of the heavy engineering and machine building industries, castings and forgings, alloy tool and special steels etc.

The following table gives the progress of principal industries through the plans and their Third Plan targets:—

Industry	Unit	End of First plan (1955-56) production	End of Second plan (1960-61) Capacity	End of Second plan (1960-61) production	Third plan Targets (1965-66) capacity	Third plan Targets (1965-66) production
1. *Iron and Steel*						
(a) Finished steel	'000 tons	1300	4500	2200	7500	6800
(b) Pig iron (for foundries)	,,	380	900	900	1500	1500
2. *Structural Fabrication*	,,	90000	500000	150000	1100000	1100000
3 *Ferro-Manganese*	,,	.	150000	100000	220000	200000
4. *Aluminium*	,,	7300	18200	18500	87500	80000
5. *Locomotives*	number	179	300	295	360	1841 (61 to 66)
6. *Automobiles*	,,	26800	72000	66000	138000 to 150000	140000
7. *Heavy chemicals*						
(i) Sulphuric Acid	tons	164000	476000	363000	1750000	1500000
(ii) Soda Ash	,,	81000	268000	145000	530000	450000
(iii) Caustic Soda	,,	35000	124000	100000	400000	34000
8. *Fertilizers*—						
(i) Nitrogenous (fixed Nitrogen)	,,	79000	248000	110000	1000000	800000
(ii) Phosphatic (as P_2O_5)	,,	12000	60000	55000	500000	400000
9. *Ship Building*	GRT	50000 (51-56)	20000	20000	50to60 thousand	50 to 60 thousand
10. *Cement*	'000 tons	4600	9000	8500	15000	13000
11. *Cotton Textiles*						
(i) Yarn	'000 lbs	1640000	2100000	1750000	2250000	2250000
(ii) Cloth (produced in mills)	'000 yds	5102000	5300000	5127000	5800000	580000
12. *Jute*	lakh tons	11 5	12	10·6	12	11
13. *Sugar*	'000 tons	1860	2250	3000	3500	3500
14. *Bicycles*	number in thousand	510	2200	1050	2200	2000
15. *Paper and paper board*	lakh tons	1 87	4·10	3·50	8 20	7 0
16. *Newsprint*	tons	4200	30000	25000	150000	120000
17. *Glass and Glasswares*	lakh tons	1·25	3·70	2 25	6 15	4 40
18 *Petroleum products*	'000 tons	3600	6020 (Crude oil)	5670	10770 (Crude oil)	9860
19. *Salt*	,,	3000	3900	3700	6500	5400
20. *Vanaspati*	lakh tons	2·76	4 34	3·30	5·50	5·00
21. *Sewing Machines*	number	111000	268000	297000	700000	700000

The 1958 Census of Indian Manufactures revealed that India had 8052 registered factories, which employed 1.8 million persons Salaries and wages paid to employees amounted to Rs 268 1 crores The total value of the products of these industries was Rs 1717 crores.

The Industrial policy of the Central Government, (declared on 30th April, 1956) aims at speeding up industrialisation and to develop heavy industries and machine making industries Under this policy, the industries have been divided into three categories:—

(i) Industries the future development of which would be exclusive responsibility of the State. Under this category have been placed 17 industries

(1) Arms and ammunitions and allied items of defence equipment

(2) Atomic energy

(3) Iron & Steel.

(4) Heavy castings and forging of iron and steel.

(5) Heavy plant and machinery required for iron and steel production, for mining, for machine tool manufacture and other basic industries.

(6) Heavy electric plant including hydraulic and steam turbines

(7) Coal and Lignite

(8) Mineral oils

(9) Mining of iron, manganese, chrome ores, gypsum, sulphur, gold and diamond.

(10) Mining and processing of copper, lead, zinc, tin, molybednum and wolfram.

(11) Minerals specified in the Schedule to the Atomic Energy Order, 1953

(12) Air Craft.

(13) Air Transport.

(14) Railway Transport.

(15) Ship-building.

(16) Telephones and telephone cables

(17) Generation and distribution of electricity.

(ii) Industries which would be progressively State owned and in which the State would generally take initiative in establishing new undertakings, but in which private enterprise would also be expected to supplement the efforts of the State. Such industries are —

(1) All other minerals except 'minor minerals' as defined in Sections of the Minerals Concession Rules, 1949

(2) Aluminium and other non-ferrous metal not included in 'Schedule A'.

(3) Machine Tools

(4) Ferro-alloys and tool steels.

(5) Basic and intermediate products required by chemical industries such as the manufacture of drugs, dye-stuffs and plastics.

(6) Anti-biotics and other essential drugs.

(7) Fertilizers.

(8) Synthetic fertilizers.

(9) Carbonation of Coal.

(10) Chemical pulp.

(11) Road Transport.

(12) Sea Transport.

(iii) All the remaining industries, whose development would in general be left to the initiative and enterprise of the private sector.

Selected Statistics of Industrial production

	unit	1950	1955	1961	1962
Cotton Cloth	Lakh metres	42,620	62,610	70,700	52,930
Cotton yarn	Lakh kgs	5,330	7,400	8,620	6,460
Jute Manufactures	000 tonnes	847	1,044	970	891
Steel Finished	Lakh tonnes	102	128	285	207
Coal		325	388	561	449
Sugar	000 tonnes	992	1,620	3,029	..
Cement	lakh tonnes	27	46	82	62
Paper & paper Board	000 tonnes	111	188	364	286

*Based on *India 1963* p 263 (Govt of India)

Machine Tools	lakh rupees	27	74	761	771
Bicycles (complete)	000 nos.	103	591	1,047	850
Sewing Machines	,, ,,	31	101	317	263
Caustic Soda	000 tonnes	11	35	120	92
Soda ash	,, ,,	44	79	177	159
Sulphuric Acid	, ,,	104	169	414	333

The Third Five Year Plan has placed the following priorities for the development of industries in the country —

(1) increased production of iron and steel and of heavy chemicals including nitrogenous fertilizers, and development of the heavy engineering and machine building industries,

(2) expansion of capacity in respect of other developmental commodities and producer goods such as aluminium, cement, chemical pulp, dyestuffs, and phosphatic fertilizers, and of essential drugs,

(3) modernization and re-equipment of jute, and cotton textiles and sugar which have already come,

(4) fuller utilization of existing installed capacity in industries where there are wide gaps between capacity and production, and

(5) Expansion of capacity for consumer goods keeping in view the requirements of common production programmes and the production targets for the decentralization sector of industry.

IRON AND STEEL INDUSTRY

The iron and steel industry is the basic industry of the modern world But the art of manufacturing iron was known to India at least one thousand years before Christ The iron pillar at Delhi is a standing proof of the quality of the iron produced in India in ancient times The famous Damascus blades of the Saracens were made of the Indian material In modern times, the first attempt at steel making in India was made by an I C S officer, named Joshiah Heath. His scheme failed It was the Barakar Iron Company, which later passed into the hands of the Bengal Iron Company, that first succeeded in this object.

But it was only when the Tata Iron and Steel Company took up this work that steel production was started in India The original project of the Tatas was to make 1,20,000 tons of

pig-iron and 70,000 tons of steel per year The growth of the Tatas has, however, been remarkable. The Company's works at Jamshedpur are expanding to be able to produce much larger quantities of pig-iron and steel. This increased production by the Tatas together with the production of the Indian and Iron Steel Company of Bengal and of the Mysore Steel Works is expected to meet the normal demand in India.

The most important factors in the development of the modern iron and steel industry are —

(a) Raw materials, (b) fuel and (c) market The other factors like communication, skilled labour and locational advantages are of minor importance.

While considering the development of the iron and steel industry in India, the first thing that strikes us is the lack of adequate market The products of this industry are in demand mostly by industrialized urban societies Machinery and tools for the factories, rails, wagons and cars for communications, steel girders and door frames for buildings, and thousand and one such things of steel are in demand by urban societies today India is backward industrially. She has very few towns, she has very few railways; she has very few cars The natural result is that she has very little of iron and steel industry.

The other thing that strikes us is India's poverty in coal Coal is the only important fuel that is used in the iron and steel industry today Electric furnaces are in use in some countries like Sweden, Switzerland and the U S A. But their output is negligible, besides they handle only a special type of iron-ore India's lack of suitable coal for iron and steel manufacture is, therefore, her greatest drawback in developing this industry

As good coal is indispensable for iron and steel manufacture, we notice that practically the whole of this industry in India is centred near the coal-fields of Jharia. The supplies of iron-ore are widespread over the Peninsula, but they are seldom utilized, as they are not easily accessible to coal.

But while India is poor in suitable coal and has little market for iron and steel goods, she has immense supplies of good quality iron-ore It should be possible to take this ore to places where coal is easily available to smelt it. This can be taken to places on the coast where iron and steel works can be started with the help of imported coal This is being done by Brazil, which is importing coal for the purpose from U. S. A.

But the market for steel must be enlarged first. It is also believed that the new Knipp-Renn process of steel manufacture enables the use of inferior coals in smelting iron-ore The pig-iron produced by this process is later refined with the help of electricity which can again be made from inferior coal With this process India can make the cheapest steel in the world. About two-thirds of the cost of steel-making is on account of raw materials. India uses a very rich iron-ore containing 60% to 69% of metal in it. In Europe and in America most of the ore used is poorer in metal (40% in Europe and 50% in U.S A) Indian iron-ore is a very low phosphoric ore, having only about $\frac{1}{4}$% of phosphorus. The European ores contain $1\frac{1}{2}$% of phosphorus and, therefore, are costlier to refine The coal used in India for smelting is practically free from sulphur This is not the case in Europe and America The labour charges in India are much lower than in Europe or America India also possesses immense quantities of good quality iron-ore In Singhbhum district it is estimated that there are 1000 crore tons of such high grade ore At the present rate of consumption this ore should last for about 2000 years

The following table gives the annual per head consumption.—

U S A.	1,237 lbs.
U. K.	628 "
Australia	480 "
U S. S R.	240 "
France	322 "
Belgium	501 "
India	12 "

The present iron-manufacturing centres in India can be divided into two classes :—

(1) The pig-iron and steel manufacturing centres; and

(2) The pig-iron manufacturing centres.

Steel manufacturing requires proportionately more iron-ore than coal, while pig-iron requires, proportionately more coal than iron-ore. The Indian Tariff Board of 1924 calculated that for manufacturing 1 ton of pig-iron $1\frac{3}{4}$ tons of iron-ore and $1\frac{2}{3}$ tons of coking coal are required in India; while for 1 ton of finished steel, 2 tons of ore and $1\frac{5}{6}$ tons of coking coal are required.

The biggest iron and steel works in India, the Tata Iron and Steel Works at Jamshedpur are, therefore, situated nearer to the iron-ore supplies than to coal supplies.[1] The smelting works at Kulti, Burnpur and Dhanbad—producing mostly pig-iron —are situated, on the other hand, nearer to coal iron-ore.

According to the 1958 Census of Indian Manufactures, there were 167 large and small iron and steel works in India. in which about Rs 183 crores of capital was invested and 93,288 persons were employed.

There are at present four main producers of iron and steel, *viz* —

(i) The Tata Iron and Steel Co., Jamshedpur.

(ii) The Indian Iron & Steel Co

(iii) Mysore Iron & Steel Works, Bhadravati

(iv) Hindustan Steel Limited at Drug, Bhilai & Rourkela.

The total capacity for pig-iron and finished steel is estimated to be 2771000 tons and 1730000 tons per annum respectively. The industry is mainly concentrated in Bihar and West Bengal.

(i) Tata Iron & Steel Company

The site of the Jameshedpur Works has been selected in a narrow valley formed by the river Subarnarekha and the Khorkai (shown by R in the map—next page) rivers in the district of Singhbum in Bihar The valley is only about three miles broad where the works are situated between the two rivers The sketch map shows that this is the only-fairly extensive, flat and low-land area available in the vicinity of the hills that extend miles around. Iron works require large areas of flat land for their operation This valley is, therefore, an advantage to the Jamshedpur Works The hills to the south of this valley are the source of the coveted iron ore deposits of Orissa The main source of iron-ore supply of the Jamshedpur Works lies in these hills within 60 miles. The coal supplies come from the Jharia coalfield at an average distance of about 100 miles The two rivers, the Subarnarekha and the Khorkai supply the Works with water The water requirements in the iron works are very large The presence of these rivers is, therefore, a great advantage enjoyed by Jamshedpur These rivers

1 The Tatas use annually about 20 lakh tons iron-ore of which Noamundi supplies about one-half, Gurumashisani, Badampahar and Sulaipat supplying the rest They use annually 25 lakh tons of coal of which Jharia supplies about 15 lakhs Manganese comes from Bara Jamda, Jharia supplies about 15 lakhs Manganese comes from Bara Jamda, and limestone from Birmitrapur, Hathibari and Baraduar They use about 6 lakh tons of limestone annually Dolomite comes from Pagposh and Fireclay from Belapahar.

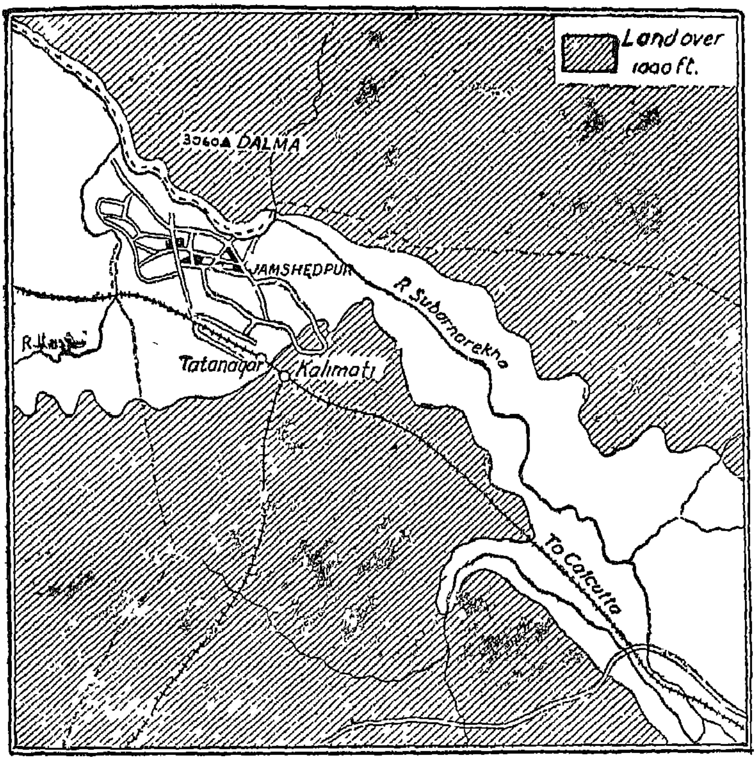


Fig 43. Site of Jamshedpur

are irregular in flow and almost dry up during summer. The water is, therefore, pumped from the Khorkai, which is nearer the Works, and stored in a tank The bed of the Khorkai also supplies sand which is used in making moulds for pig-iron. The Works are served by the main line of the E. Ry , joining the two most important towns of India—Bombay and Calcutta which provide the biggest markets for Tatas' products The iron-ore and coal supplies are brought to the Works by the branch lines of this railway.

The only important raw material which comes from longer distances is the flux (limestone or dolomite). Unfortunately, most of the larger occurrences of good limestone lie at distances above 200 miles from the Jamshedpur Works The limestones found nearby are inferior, and irregular in quality of the material Recently a large deposit of rich dolomite has been discovered near Sulai, a village situated a few miles from Dhatura

station on the line of the E. Railway near Jharsugudha in Orissa. A great importance attaches to this discovery in view of the easy communication both with Tatanagar and Burnpur. The Jamshedpur Works first got their supply of lime stone from Katni near Jabalpur, but now they operate their own quarries at Pagposh, in Gangpur, which produces a dolomatic limestone which is inferior to the true limestone

The other raw materials, manganese ore, fire clay and chemicals are required only in small quantities, and are available near at hand.

The Jamshedpur Works are situated in a region that is infertile and very thinly populated The inhabitants of the region are the backward Santhal tribes who do not care to work in factories. The labour force is, therefore, recruited from the densely populated valley of the Ganga mostly Bihar, U.P. and M.P The skilled labour is now mostly Indian and only partially foreign.

The Tata Iron and Steel Company has developed plans for the modernization and expansion of its Steel Works at Jamshedpur The normal capacity of the plant at present is about 20 lakh tons of steel ingots (15 lakh tons of finished steel) per annum.

At the end of the Second Plan period the target was reached. In 1961 TISCO produced 875588 tonnes of finished steel, and 20868 tonnes of saleable pig-iron. In 1962 its production of finished steel and saleable pig-iron were 948422 and 22112 tonnes respectively.

Establishment of an uptodate plant for the manufacture of refractories required by the steel industry and a plant for the utilization of blast furnace slag in the manufacture of light weight aggregate and hollow blocks has been completed It is understood that the firebrick plant will meet most of the requirements of the Steel Works in the way of refractories and as the plant is equipped with the most modern machinery for efficient and large-scale production employing the latest labour-saving devices, it is expected that this new ancillary unit will be of very great help not only in reducing the cost of steel but would also make the Tata Iron and Steel Works rely on its own resources for this important raw material The Steel Company has already vast resources of suitable raw material for the firebrick plant.

Efficient utilization of industrial wastes, such as blast furnace slag has received considerable attention of the Steel Company. Economic utilization of the slag has been studied over

a number of years and the proposal now made to manufacture light weight aggregate and hollow blocks would go a long way to ease the situation for the supply of a building material that is light, cheap and has better heat insulation properties

(ii) Indian Iron & Steel Company

Under the Steel Companies Amalgamation Act (1952) the Indian Iron and Steel Co has been amalgamated with the Steel Corporation of Bengal and the new company has been named the Indian Iron and Steel Company.

The important pig-iron manufacturing centres of Kulti and Burnpur are situated on the coal-fields They are in a thickly populated area where the network of railways joins them to Calcutta which is the largest iron market in India The exports of pig-iron manufactured by these centres also go via the port of Calcutta.

The iron works at Kulti, on the Barakar river, a tributary of the Damodar river, are the oldest existing iron works in India. The site of the works was originally chosen on account of the proximity of both coal and iron-ore The out-crop of the iron-stone shales, between the coal-bearing BARAKAR and RANIGANJ rock stretches east and west from the Works, and for many years the clay nodules of this iron-stone constituted the only supply of ore used at these Works Now, the richer ore from the deposits in Kolhan has taken the place of iron-stone shales

The coal supply is obtained from the Ramnagar Collieries only two miles from Kulti, and from the adjoining collieries of Noonodih and Jitpur in the Jharia field The limestone is obtained from Bisra (Gangpur), and also from Paraghat and Baraduar on the N E. Rly

The Burnpur Works are situated in the triangle made by the N E Rly and the E Rly near Asansol. The works are only 132 miles (211 kms) away from Calcutta The ore supplies come from Gua, in Kolhan There is a branch railway line to Gua Coal is obtained locally Water supplies are obtained from a large reservoir on the works into which it is pumped from the Damodar river which is 2½ miles (4 kms) away.

Recently iron smelting has been started at Belur near Calcutta also.

By the end of the Second Plan the Indian Iron and Steel Co. (IISCO) were expected to increase their production to 1 million tons of steel ingots (8 million tons of finished steel) in 1961 IISCO produced 267873 tonnes and 563054 tonnes of sale-

able pig-iron and finished steel respectively and in 1962 the production of respective items were 204298 and 613720 tonnes.

(iii) Mysore Iron and Steel Works

A distant iron-smelting centre is far away in Mysore where no coal is found. Charcoal, therefore, makes up the shortage of coal. It is obtained from the rich forests of Mysore for smelting iron-ore This is the only large centre in India using charcoal in place of coal The works are located at Bhadravati

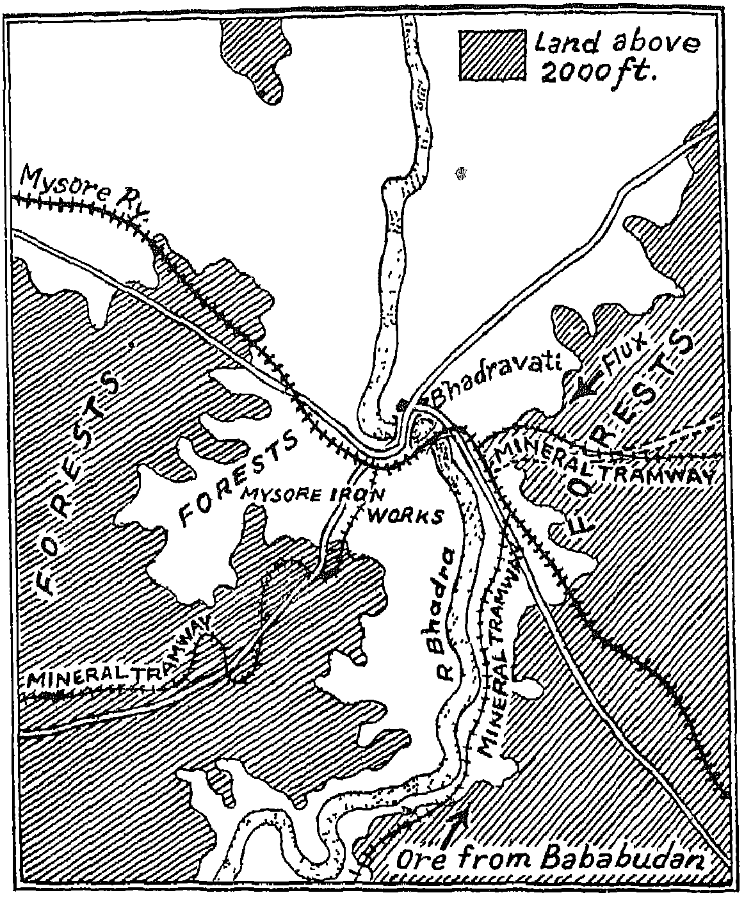


Fig 44 Site of Bhadravati works.

on the Birur-Shimoga branch line of the Southern Railway, about 11 miles (17 6 Kms) east of Shimoga The site has been selected on the west bank of the river Bhadra where its valley widens to about 8 miles (12 8 kms) Immediately in the neigh-

bourhood are large reserves of forest The raw materials are transported to the works by tramways and the Birur-Shimoga meter-gauge railway The ore comes from Kemmangundi on the top of the Bababudan hills, about 26 miles (41 6 kms) south of Bhadravati It was first proposed to bring the dolomite flux from Tumkur district but the cost of transport being heavy, the proposal was given up Limestone is now used as flux and is obtained from Bhandigudda near Gangpur 13 miles (21 kms.) east of Bhadravati The Bababudan hill ores need mixing with siliceous ores These ores are obtained from a quarry opened up near Birur The wood required for making charcoal by distillation comes entirely from the jungle trees which cannot be made use of for any better purpose The Bhadravati works are better situated in respect of ore and flux supplies than any other large iron-smelting centre in India The ore used is, however, inferior

Apart from the major production of pig-iron or steel in the iron works, the works also produce a large quantity of chemical by-products from coke Coaltar and ammonium sulphate are the important by-products in the works where coke is used for smelting, *i.e.* in Tatanagar and Kulti, etc, while lime acetate, wood alcohol and wood-tar are the by-products at Bhadravati where charcoal is used. The manufacture of cement is another industry started recently at Bhadravati to make use of some of the by-products of the iron works, especially slag

India's production of pig-iron or steel is insignificant when compared with that of the leading industrial countries of the world It gives us great shock however, to know that we produce even less than either Italy, Poland, Canada, Sweden, Austria or Hungary—all countries where, as in our case, agriculture is the dominant occupation.[1]

The following table gives the production of pig-iron and ferro-alloys and crude steel in some important countries of the world as compared with India (1958):—

Countries	Pig-Iron and Ferro-Alloys ('000 Metric tons)	Crude Steel ('000 Metric tons)
India	2145	1842
U S A.	53403	77342
U S. S R	39600	54871
Fed Republic of Germany	16755	22785
U K.	13183	19879
France	12142	14607
China (mainland)	9500	8000
Japan	7691	12118

1. In 1955, crude steel production in these countries was (in million long tons) Italy 5 31; Poland 4 37; Canada 4.04; Hungary 1 57.

Due to lack of market in India, prior to independence smelting industry had become the source of exporting our iron-ore to foreign countries in the form of pig-iron. By this method the foreign countries were able to get from India the metal without the impurities contained in the iron-ore. Iron-ore is a heavy and bulky material whose export to distant countries is not economical if exported as ore. If, however, it is exported as bricks of pig-iron, the cost of transport is negligible England and America could thus purchase pig-iron from us and send it back to us as finished steel or machines at a much higher price

Although the United States of America is one of the world's largest producers of pig-iron, she imports considerable quantities from India because of the unusual characteristic of Indian pig-iron which gives it special value in the manufacture of steel Pig-iron is mixed with scrap steel in the open hearth furnaces to make steel. The more scrap steel which can be used with the pig-iron, the less expensive and more desirable will the resulting steel be Indian pig-iron is a good scrap carrier, *i.e.* it makes possible the use of a greater amount of scrap, and because of this, American steel producers are willing to pay a higher price for Indian pig-iron than for American pig-iron

The following table gives an idea of the pig-iron of Indian iron and steel industry —

(In 000 Tons)

	1950	1952	1953	1954	1955	1957	1958	1960-61
Pig-iron	1,562	1,658	1,659	1,793	1,757	1,789	2,011	4,100
Direct Castings	98	129	115	127	126	113	72	.
Ferro-alloys	18	41	7	41	12	10	26	40
Steel ingots	1,438	1,578	1,507	1,685	1,704	1,715	1,813	3,500
Semi-manufactured Steel	1,142	1,308	1,230	1,452	1,457	1,440	1,599	
Finished Steel	1,004	1,103	1,018	1,243	1,260	1,346	1,300	2,200

In 1961 India produced 49 8 lakh tons of pig-iron and 28 1 lakh tons of finished steel In 1962 the production of pig-iron and finished steel was 57 9 lakh tons and 36 6 lakh tons respectively.

High priority has been given to the expansion of capacity for producing steel and pig-iron in India.

1960-61		1965-66	
Capacity	Production	Capacity	Production
(million tons)		(million tons)	
4 5	2·2	7 5	6·8
9	·9	1 5	1 5

India exports a large quantity of pig-iron from the port of Calcutta. The chief markets for Indian pig-iron are U.S.A., U. K and Japan-Scrap iron and steel for remanufacture go mainly to U.K. and Japan

The Iron and Steel (Major) Panel in 1946 estimated the normal consumption of steel in India at 2 million tons as against the pre-war consumption of 1 million tons. It was estimated at $1\frac{1}{2}$ million tons by the Advisory Planning Board; and 2 9 million tons by 1954 by the Sub-Committee on Iron and Steel (of the E C.A F.E). Taking the development of agriculture and industry into consideration, the IIIrd plan requirements of steel ingots would be nearly 92 lakh tons by 1965-66.

Under the Third Five Year Plan:—

The targets for the Third Plan are as follows·

	Third Plan Targets	
	(1965-66)	(In million tons)
	Capacity	Production
Finished Steel	7 5	6 8
Pig-iron for foundries	1 5	1 5
Steel Ingots	10 2	9 2

The capacity of the three integrated iron and steel plants in the public sector (Hindustan Steel Ltd.) is proposed to be doubled by the end of the Third Plan. The capacity of Rourkela plant is to be expanded to 1 8 million tons of ingots per annum, of the Bhilai plant to 2 5 million tons, and of the Durgapur to 1.6 million tons of steel ingots per annum

Besides a new steel plant at Bokaro (capacity—10 lakh tons of ingot) and a special steel and a special alloy plant at Durgapur are also to be set up

Rourkela Steel Plant

Rourkela is 257 miles from Calcutta on the main railway line between Calcutta and Bombay It is at the confluence of the river Sankh and Kool which go to form the Brahmani The plant under construction is for one million tons of crude steel to be rolled into 720,000 tons of plates, sheets and strips The capacity of the plant can be expanded with a few additions to 1.3 million tons The layout provides for ultimate expansion to two million tons

1 Iron-ore will come from a new mine which is being developed in Barsua about 45 miles away Coal will be drawn from the Bokaro, Kargali and Jharia fields of Bihar

2. The Bokaro and Kargali coals will be washed, to reduce the impurities, in a washery newly set up at Kargali Jharia coals will be unwashed for the first year of operation Later, they will be washed in a washery to be put up in Dugda near the coal fields

3 The washed coals will be brought over a new railway line from Dugda to Rourkela

4. Limestone will come from Hathibari and Birmitrapur about 15 miles (24 kms) away

5. The Mandira Dam built across the river Sankh will provide an unfailing supply of water to the Plant

6 A power plant of 75,000 kw is constructed within the steel works and during peak hours additional power will be obtained from Hirakud hydro-electric system

In this plant 250,000 tons are to be made by the open hearth process, and the other 750,000 tons by a new process called the L D (Linz Donawitz) process. This process, it is claimed, has the advantage of lower capital and operating costs, higher rate of production and saying in space and ancillary equipment It also releases by-products for the manufacture of fertilizers and a series of important chemicals In the plant there are three blast furnaces, each with a capacity of 1000 tons per day.

The steel plant is designed to make the following products.—

Plates 3/16″ and above	200,000 tons
Sheets and Strips (hot rolled)	300,000 tons
Sheets and strips (cold rolled)	170,000 tons.
Tin plates .	50,000 tons

Preparation of the detailed project report, the layout, documents for tender and supervision of the work both of manufacture and construction and erection—is the responsibility of a combine of two known German firms Krupp and Demag,

The construction of the million-ton stage is almost complete. Except the three of the six hot dip tinning pots all the units have been commissioned Rourkela steel plant produced over 6 5 lakh tonnes of pig-iron and over 6 lakh tonnes of steel ingots in 1962 (The Rourkela fertilizer plant has also been commissioned in November, 1962). The annual capacity of the plant is to be increased to 18 lakh tons of ingots which will be rolled into 12 4 lakh tons of finished steel.

Bhilai Steel Plant

The plant completed is for one million tons of crude steel to be rolled into 770,000 tons of billets, rails and structural sections. The capacity of the plant can be expanded, with a few additions, to 1 25 million tons The lay-out provides for ultimate expansion to 2 5 million tons

1 Iron-ore will come from a new mine which is being developed in Rajhara, about 60 miles (96 kms.)

2 Coal will be drawn from Bokaro, Kargali and Jharia fields in Bihar and from Korba in Madhya Pradesh

3 Limestone will come from new quarries being developed in Nandini, 12 miles (19 kms.) from Bhilai.

4 A system of reservoirs at Tandula reinforced by the Gondle reservoir through the Tandula canal supply water to the plant The main source of power will be the thermal station under construction at Korba In addition 24,000 kw will be generated at thermal station within the steel works

5 Manganese will be had from the neighbouring districts of Bhandara and Balaghat

6 A very long area of bhatta land near Bhilai is very suitable for building purposes

Iron will be converted into steel by the conventional open hearth process in six furnaces of 250 tons capacity each The rolling mills consist of one blooming mill, one continuous billet mill, one rail and structural mill and one merchant mill These will convert one million tons of ingots into the following products:

Rails, standard gauge .	100,000
Rails, narrow gauge	10,000
Railway sleeper bars ..	90,000
Standard and broad flanged, channels, angles and other light and heavy structural sections (beams with section height upto 24")	284,000
Rounds from 7/8" to 3" dia & squares with sides 7/8" to 3"	121,000
Flats from 2" to 5" wide	15,000
	620,000
Billets for re-rolling at outside rolling mills from 2" × 2" to 3" × 3" cross section.	150,000
	770,000
Pig-Iron ..	300,000

The plant is being put up with the technical and financial co-operation of the Government of USSR. The main plant and equipment worth Rs 631 million is supplied on credit repayable in 12 equal annual instalments, interest will be at 2½ per cent Other stores which cannot be obtained in time in India, are supplied on cash terms

The plant has already exceeded the rated capacity in the production of pig-iron, steel ingots and finished steel. During 1962-63, the first financial year of the whole plant in operation, the production of pig-iron and steel ingots which was 11 7 and 10.6 lakh tons was 105 and 106 percent of the rated capacity A contract has been signed between the Hindustan Steel Ltd. and Russian Organisation 'Tyazhpromex-port' in February 1962, according to which the capacity of the plant is to be expanded to 25 lakh tons of steel ingots per annum which will be rolled into 19.5 lakh tons of finished steel Bhilai plant will produce 3 lakh tonnes of pig-iron for sale

Durgapur Steel Plant

In Durgapur, the plant will be supplied with iron-ore from the new mines being developed at Bolani in Orissa.

Also, metallurgical coals of Jharia will be blended with the high volatile semi coking coal of Barakar

Limestone for this plant will be obtained from the Birmirapur Hathibari areas

Water for the plant will be supplied from Damodar river through a channel which is being constructed by the Damodar Valley Corporation The D V C is also putting up a 150,000

MAIN FEATURES OF BHILAI AND ROURKELA STEEL PLANTS

Items	Rourkela plant	Bhilai Plant
Coke ovens	3 batteries of 70 ovens each	3 batteries of 65 ovens each
Blast Furnaces	3 of 1,000 tons capacity each	3 of 1,135 tons capacity each
Steel melting	2 mixers of 1,000 tons each	1 mixer Six 0 H furnaces of 250 tons each
	3 L D converters of 40 tons each	
	4 Basic Stationery open Hearth Furnaces of 80 tons each	
Rolling Mills	1 Blooming and slabbing mill 1 Heavy Plate mill 1 continuous strip mill 1 cold rolling mill with two sets of stands	1 Blooming mill 45 2' 1 Rail and Structural mill 1 merchant mill 1 continuous billet mill
Power Plant	75,000 kw	24,000 kw

kw thermal station primarily to supply the steel works Besides this, there will be a stand by station within the works of capacity 15,000 kw

The works contain three coke oven batteries with 78 ovens each, as well as a By-product plant. There will be three blast furnaces with a capacity of 1,250 tons per day It is being constructed in collaboration with English firms

It was completed in 1962 and the third blast furnace, third coke oven battery, and the wheel and axle plant were brought into operation By the end of 1962 the plant achieved the full rated capacity in the production of pig-iron and 92 per cent capacity in the production of steel ingots The Third Plan target of the plant is 16 lakh ingot ton capacity to produce 12 4 lakh tons of saleable finished steel and semis in addition to 3 lakh tons of saleable pig-iron

An Alloy and steel plant is being proposed to be set up at Durgapur with an initial capacity of 80,000 ingot tons capable of being rolled into 48,000 tons of finished products The preliminary work has started

Personnel for Steel Plants

For each plant 700 Engineer Officers and about 6,300 skilled workers have to be found For the training of these 2,100 Engineers and 19,000 skilled workers, including 3,000 operatives, a big training school was set up at Jamshedpur and smaller ones at Burnpur and Bhadravati Through the good offices of the Ford Foundation, the programme of training 900 Indian Engineers in Steel Works in U S A has made considerable progress U S S R are training 700 Engineers for Bhilai, U K 300 Engineers for Durgapur, West Germany about 150 for Rourkela and Australia will train about 100 Engineers under the Colombo Plan and further a few will be training in Canada also Already 1,200 engineers have been sent abroad of whom 600 have returned

The Tatas have also given the maximum assistance possible. Not only are they training men but they have also allowed about 100 of their experienced steel men to come to these plants in the public sector to man some of the important posts

For each of the steel works new townships are being built to provide 7,500 houses for the workers and other staff and the usual facilities are being provided for a population of 100,000 people These town-ships are coming up in well planned sectors, each of which is a self contained unit with its health and civil centres and own shopping centre Other amenities including municipal services and water and electric supplies are being provided for

Expenditure on Construction

The present estimates provide for an expenditure of 439 crores for the three plants proper for Rourkela 170 crores, for Bhilai 131 crores and for Durgapur 138 crores These estimates do not include the cost of townships, ore mines and quarries, land prospecting and designing, development of sources of water supply, power supply facilities upto the perimeter of the plant, personnel required for operation including the cost of training, railway works, outside the perimeter of the plant, personnel employed directly by the project, customs duty, expenditure on medical services, office expenditure and such other ancillary expenditure A provision of Rs 120 crores has been made for these items but again the increases in the cost due to rising of prices have not been taken into account.

COTTON TEXTILE INDUSTRY

Though the first cotton mill (Bowreah Mill) was started at Calcutta in 1818 the industry may be said to be really born in Bombay in 1854 The cotton textile industry is by far the most important manufacturing industry in India This is known by the fact that of the average daily number of workers employed by different manufacturing industries in India in November, 1960, about 9 lakhs were employed in cotton mill industry This was the largest number employed in any single industry Hence the basic importance of the cotton industry to the well-being of the people can be easily gauged

The localization of the cotton mill industry depends upon many factors, such as the supply of raw material, fuel, chemical, machinery, labour, communications and market Any of these factors may determine the location of this industry, provided it gives a decided advantage in competing against other locations of this industry Thus, Lancashire in England does not produce any raw cotton, nor does it enjoy locally any considerable market for the products of cotton mill industry But it commanded, through political control, a vast market in commonwealth countries This one factor led to the tremendous development of the industry there The ease with which the raw cotton can be imported from U S A , and the nearness to coal-mining areas, which supplied not only fuel and machinery but also cheap labour of women and children from the families of miners and workers in iron works, were all secondary advantages Similarly, the access to the Indian and other neighbouring markets was an incentive to the development of this industry in Japan Japan also does not produce any raw cotton It imports most of it from India The vast supplies of cheap labour, and cheap ocean transport together with Government support in various ways helped the development of cotton industry in Japan.

In India, the localization of the cotton mill industry has been brought about chiefly by the following factors —

(a) supply of raw material;
(b) ease of importing machinery and mill stores from abroad, and
(c) the vast market

Supply of coal has not played any important part in locating cotton mills For the amount of coal needed by the mills is negligible when compared with the vast amounts of raw cotton, finished goods or machinery that have to be moved Climate also does not play any direct part For artificial humidity supplied to the spinning rooms controls the moisture conditions of air quite efficiently without much cost

Towards the earlier part of 1962 there were 480 cotton textile mills (195 spinning and 285 composite) in India, with 13 83 million spindles and about 2 lakh looms. Nearly Rs 122 crores were invested in the industry and about 8 9 lakh workers employed at the beginning of 1961

The following table shows the growth of Cotton mills in India —

Year ending 31st August	No of Cotton mills	No of Spindles installed (In million)	No of Looms Installed	Average No of workers employed daily	Cotton consumed in million bales of 392 lbs each
1938[1]	380	10 02	200,886	437,690	3.66
1947[1]	423	10 35	202,662	488,370	3 97
1948	408	10.26	197,419	466,477	4 20
1950	425	10.85	199,775	433,816	3 79
1952	453	11 43	203,786	432,588	4 13
1954	461	11 89	207,763	435,421	4 69
1956	465	12 37	206 580	789,024	4 99
1958	511	13 71	205,598	775,865	4 64
1959	516	13 53	205,973	884,628	5 07*

The greatest advantage possessed by the Indian cotton industry is the extent of the home market The significance of this advantage can be realised from the fact that for the two countries from which India drew practically the whole of the imports of manufactured cotton, *i.e.* Great Britain and Japan; she

1 Relate to undivided India

*of 400 lbs.each

represented the largest single export market. An idea of the enormous extent of the Indian market can be gathered from the fact that, although imports into India in 1931 did not represent in quantity more than 15 p c of the total consumption of cloth in the country they represented for each of the above two countries the largest single line of export

The largest centres of cotton industry in India are where raw cotton is abundant. Bombay obtains the raw material from stocks brought to Bombay for export, as practically all the raw cotton is exported through it It has also the advantage of importing machinery and mill stores from abroad easily

Bombay and Ahmedabad are the principal centres of the industry, about one-third of the total number of mills in the country are at these two places now Elsewhere in the country, the cotton mills are scattered wherever facilities of raw material are available In the cotton mill industry, market and the raw material play the most important part

The following table gives the distribution of cotton textile industry as in August, 1959 in India:—

Location	No of Mills	No of spindles installed	No of looms installed	Av No. of Workers employed	Approx. quantity of Cotton consumed in bales of 392 lbs each
Gujarat and Maharashtra	199	70,02,104	1,37,973	4,96,608	25,06,825
Madras	133	29,52,100	7,371	1,21,122	8,88,834
W. Bengal	30	6,02,834	9,075	43,862	2,18,778
U. P	23	8,32,698	13,716	57,706	3,59,760
Mysore	17	4,64,140	4,970	31,883	1,78,195
Madhya Pradesh	19	5,05,412	12,657	53,567	3,11,796
Andhra Pradesh	13	1,91,610	1,219	13,654	98,005
Kerala	13	2,02,868	1,506	11,455	66,244
Rajasthan	11	1,74,558	3,465	10,657	97,308
Punjab	8	1,31,528	1,616	9,560	98,730
Delhi	4	1,67,956	3,718	20,169	1,74,194
Pondicherry	3	74,808	2,114	8,531	39,393
Bihar	3	33,584	799	752	3,795
Orissa	3	60,236	864	5,342	29,847
Total	479	1,34,06,466	2,01,063	8,84,868	50,71,701

LOCATION OF THE INDUSTRY

The location of cotton mill industry is influenced by factors other than the proximity of raw material There is no material difference between the cost of transporting cotton and cotton products and hence the industry often tends to be located at centres with favourable transport relations to markets To use Weber's terminology, the material index for this industry is not much greater than one Bombay Island has always been the chief centre of cotton mill industry in India. It has less than two-thirds of the total number of the workers employed in the Cotton Mill Industry of India, followed by Madras, U.P, M P, and Bengal, etc. The most notable feature of the distribution of the industry is that even within the State the industry is localized within particular areas and regions, almost to the complete seclusion of others Thus, in Madras and Andhra the industry is mainly localised in the districts of Coimbatore, Madurai and Tinnevelly while other districts like Nellore, Vishakhapatnam, Chittoor, Cuddapah, and Tanjore have relatively very small share in the distribution of the industry Similarly, in U P the industry is located in the western districts of Agra, Aligarh, Kanpur, almost to the complete seclusion of the Eastern district. In Bengal, the industry is mostly localized in the districts of Hooghly, 24 Parganas and Khulna It is significant to note that even within these particular areas or regions,

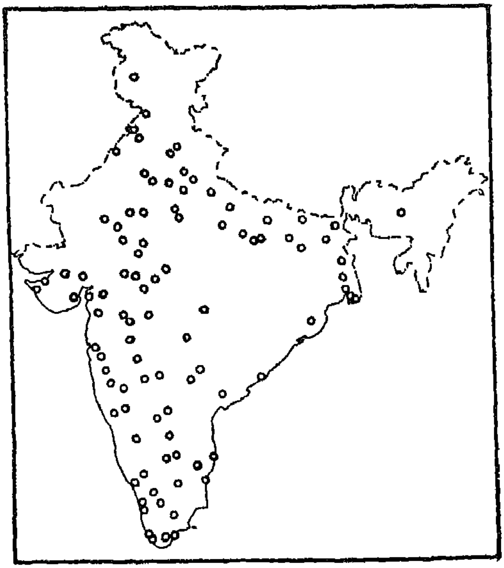


Fig. 45. Location of cotton mills

the industry is predominantly localized within a few important industrial centres like Bombay, Ahmedabad, Sholapur, Baroda, Poona, Kanpur, Delhi, Indore, Gwalior, Coimbatore, etc

There are several reasons which explain and account for initial concentration of the Cotton Mill Industry in and around the City and Island of Bombay These reasons are:—

(i) The leading Parsi and Bhatia merchants of Bombay, acquired vast financial resources from the cotton and opium trade with China, and the export of raw cotton during the American Civil War These funds were utilized in the cotton mill industry The intimate knowledge of the cotton trade enabled these merchants to exercise personal control over the details of the working of cotton mill companies and the technical skill and experience was made available by the machine-making firms of England The local agents of these firms arranged for importing, along with machinery, skilled and technical labour from Lancashire not only to fit up and supervise machinery but also to manage the mills using their machinery

(ii) The supply of raw cotton for the mills was available from the cotton-growing tracts of the country As Bombay was the leading port of export of raw cotton, the cotton crop not only of Bombay State but also of the neighbouring regions gravitated in large quantities to this port for export and a special flow of cotton to Bombay to feed its new cotton mills had not to be created

(iii) Owing to the absence of chemical and engineering industries in India, mill-stores, machinery and other accessories had to be imported from abroad, but owing to the insular position of Bombay, it enjoyed the advantages of cheap sea freight on imported articles, especially from England

(iv) Bombay, being the important junction of main railways, was also connected with the interior markets not only of raw cotton but of piece-goods too. The policy of railways to charge lower freight-rates from and to the ports increased the transport advantages of Bombay over other inland towns. Thus in spite of its producers' buying markets and consumers' markets being situated at long distances, Bombay Cotton industry enjoyed especially favourable transport facilities.

(v) For the supply of unskilled labour Bombay depended upon the coastal districts of Konkan, Satara, Ratnagiri and other parts of Bombay Deccan. Gradually workers were also attracted from distant regions like Rajasthan, West U.P, Madhya Bharat, etc

(vi) The humidity of Bombay was also a climatic advantage for the spinning of cotton thread.

Thus a fortuitous combination of all these factors led to the initial concentration of cotton mill industry in Bombay and consequently Bombay became an excellent site for the pioneer cotton mills of India So that at the end of the 19th century Bombay alone represented more than half the installed capacity of the whole of India, and inspite of a few mills here and there this island city with its 82 cotton mills could justly be called the "Cottonopolis of India"[1]

But after 1921, the dispersal of the industry set in. This process was specially rapid after the enervating depression in the Bombay textile industry which started in 1923 so that there was a relative decline in the predominant portion of Bombay and a relative increase in the industrial activity in the more and more interior regions

This change has been due to the appearance of deglomerating tendencies which act against local concentration These tendencies began as a result of :(i) increase in the land values and rents because of lack of area available for sites on the island, (ii) rise in the cost of living due to scarcity of consumption articles because of the separation of the mainland of Bombay by the Western Ghats, (iii) increase in internal cost of transport, (iv) increase in rates, taxes, town duty, water charges, etc, and lastly (vi) the change in the nature of consumers' markets and production So that Bombay lost the advantages of special transport relation and with the gradual economic development of the interior regions, the conditions for the establishment of cotton mills became more favourable and inviting

The causes responsible for the dispersal of the productive activity in the cotton mills industry may be analysed thus The initial dispersal of the industry was due to the development of the means of transport and communication in the interior regions With the penetration of the railways in the interior, many new centres sprang up Many of these centres like Coimbatore, Madura, Bangalore, Nagpur, Indore, Sholapur and Baroda were favourably situated both in regard to raw materials and the consumers' markets than the places of original locations As they were situated in the heart of the cotton-growing tracts as well as near the consumers' markets, they offered the possibility of saving double freight on raw cotton as well as finished goods with regard to foreign competition, the mills in the interior could also enjoy at least partial protection in their local markets

1. T R Sharma, *Location of Industries in India*, p 17

to the extent of saving the railway freight from the ports to the internal markets Hence, new cotton mills sprang up wherever capital and organizing ability were available

The earliest development of the cotton mill industry outside Bombay city took place at Ahmedabad, where the financial facilities and the entrepreneurial ability were in no way inferior to those at Bombay and where the mills were situated in the midst of the cotton-growing districts of Gujrat and Saurashtra It is the only centre in India which resembles the great cotton centre of Manchester situated in Lancashire region and probably for this reason it is called 'The Bolton of the East,'[1] and where Broach and Dholeras—the two important varieties of cotton predominantly used here[2] are grown and its nearness to the sea enables it to import foreign—the East Africa and the Egyptian cotton—easily, and the machinery and the mill-stores from abroad The spinners and weavers required for the industry were drawn from a class of people whose ancestors carried on hand spinning and weaving before machinery came into use The finished products could be conveniently distributed in Gujarat, Saurashtra, U P., E. Punjab, M P and Rajasthan, because of its railway connection[3] In equally favourable conditions the cotton industry reached certain other centres like Sholapur, Hubli

Besides the advantages of local supplies of raw materials cheap labour, and regional consumers' markets the cotton-growing tracts of Madhya Pradesh had an additional advantage of having the remarkable coal-mines within the State Sri J N Tata realising the importance of this region decided to locate his mills at Nagpur. The town was situated in the cotton-growing tract, it was the terminus of the Western Rly, it was within reach of supplies of coal from Warora mines and it was the chief market for many miles around It was also the centre of a large handloom industry ready for the products of Tata's weaving mills Land was also cheap, agricultural produce abundant and the distribution of the manufactures could easily be facilitated owing to the central position of the town

The first up-country mill was located outside the peninsular India—on the edge of the cotton growing region of the Indo-Gangetic plain at Kanpur Owing to its favourable geographical situation large quantities of cotton passed through Kanpur and on account of its being an important trading centre it pos-

1 T R. Sharma,

2. Report of the Bombay Textile Enquiry Committee, (1937-38), p 70

3 Report of Indian Tariff Board (1927), Vol. II, p. 390.

sessed excellent financial facilities, while cheap labour was provided by the thickly populated areas in the vicinity. It had very good location for obtaining the supplies of good coal from Bengal and Orissa.

Though West Bengal lies away from the cotton growing belts of the country, yet on account of favourable situation of the port of Calcutta for importing raw cotton, mill-machinery and stores, the nature and extent of wide market in the neighbouring states of Assam, Bihar, Orissa, Manipur, Tripura, etc. along with the supplies of good coal within the state itself, it was found practicable to set up cotton mills in West Bengal Here the climate also favours the use of cotton clothes throughout the year

The development of the hydro-electric power in the country has also favoured the dispersal of the industry. The extraordinarily rapid expansion of the spinning industry in the Madras state—particularly in Coimbatore, Madura and Tinnevelly was greatly assisted by the completion of the Pyakra Hydro-electric scheme, and the readiness of the local industrialists to take advantages of the new sources of power. Similarly, the expansion of the Singarapet was greatly helped by the construction of the Mettur Stanley Dam The completion of the Papanasam Hydro-electric scheme also helped the expansion of the industry in Tuticorin, Kovilpatti, Madura, Ambassamudram, etc. The future development of water power will further lead to a wider dispersal of the industry

The industry has also shifted from regions of high costs to those of low labour-costs In cotton textile industry wages form 20 to 27 per cent of the total costs or 40 to 54% of the total work cost; depending on the productivity of labour, level of wages, and the character of output The wages are high in centres like Bombay, Ahmedabad, Delhi, Baroda, Indore, Kanpur and Madras, etc, and they are lowest in Kerala, Ramnad, Tinnevelly, Salem, Trichinopoly, Pudukota, etc Hence, new cotton mills after 1933 have been located in centres like Madurai, Tinnevelly, Coimbatore Ramnad, Salem, Sholapur, Barsi, Gohak Dhulia, Amalner, Jalgaon, Kalol, Poltad, Nadiad, Ujjain, Beawar, Agra, Hathras, Broach and Bangalore

The new mills in the interior have captured the markets of Bombay and Ahmedabad for coarse materials in their own areas and have thus forced these centres to change the nature of their production The city of Bombay has gone to fine and Ahmedabad has gone to finer still and is leading the whole of the Indian industry in this respect From the point of progress in quality Ahmedabad resembles what they call in Lancashire the

Egyptian section of the cotton industry while Bombay the 'American section of the British Cotton Industry'

PRODUCTION

As is characteristic of the regions where the raw material is abundant, production of yarn exceeds that of cloth in India. Most of the yarn spun is coarse, mostly below 30 counts. In 1931-32, 88 p.c. of the yarn spun in India consisted of counts 1 to 30s.; and only 3 p c. of counts above 40s. This is due to the short and coarse staple of the raw cotton produced in India. Even the so-called long staple cotton in India, taking warp and weft yarn together, is suitable only for the manufacture of yarn of counts 24s. to 40s., for all the long-staple cottons in India do not have the required degree of evenness and strength The Punjab-American crop represents the largest proportion of long-staple cotton in India, but about four-fifth of this is sold by the cultivator mixed with Deshi cotton. For the production of yarn of higher counts than 40s. no suitable raw cotton is available in India.

Finer yarn is spun in Ahmedabad and Bombay from cotton imported from Egypt and the United States of America During the War, there was a considerable increase in production, *e.g.*, the production of cloth rose to about 4,800 million yards in 1943-44 But owing to shortage of coal the production could not be raised further. The growth in recent years is shown below:—

Cotton Mill Production

	Yarn (Crore lbs)	Cloth (Crore yds)	Coarse %	Medium %	Fine %	S Fine %
1948	144	431	18	60	14	8
1951	130	407	9	51	33	7
1952	145	459	11	19	26	4
1953	149	485	12	65	18	5
1954	156	450	19	71	7	3
1955	163	509	11	74	9	6
1956	167	530	13·6	71·5	8 4	6·5
1957	178	531	21·9	65·9	7·2	5·0
1958	163	492	18·9	65·2	7 1	8 8
1959	113	327	18	71	5	6

The total quantity and value of different types of cotton textiles produced in 1957, is as follows—

Coarse	..	1,164 million yards	Rs. 58 crores
Medium	..	3,503 ,,	,, 210 ,,
Fine	..	383 ,,	,, 38 ,,
Superfine	..	263 ,,	,, 31 ,,

About 80 p c. of the cloth manufactured in India, is now of medium or fine quality. The imported cotton from the U.S.A accounts for the increasing amounts of better quality of cloth produced in India.

India is now one of the largest producers of cotton textiles in the world, and the largest in Asia Her progress was particularly marked during the second World War

The production of cotton cloth and yarn was 4927 m yds and 1685 m lbs, in 1958. The reduction was due to higher labour cost, a high level of taxation and obstacles coming in the way of modernisation

In 1960 the production of cotton cloth and yarn was 5048 m. yds and 1710 m lbs respectively and in 1961 5127 million yards and 1887 5 million lbs respectively. The corresponding figures were 4988.3 m yds. and 1892 9 m lbs.

Under the Third Five Year Plan it is proposed to increase the total output of mill-made cloth from 5127 million yds, in 1960-61 to 5800 million yds, in 1965-66 and the capacity from 5300 million yds to 5800 million yds. The expansion in the capacity and output of cotton yarn is proposed from 2100 million lbs in 1960-61 to 2250 million lbs in 1965-66 and 1750 million lbs. in 1960-61 to 2250 million lbs. in 1965-66 respectively

Country	1958 Spindles (Million)	1958 Looms (Thousand)	Cloth (yds.) in
U S. A	26	350	9,539 million
U K	20	252	1,628 ,,
Japan	9	380	3,706 m sq yds
India	13	205	5,317 m yds

The export market for our cotton industry is very small. Our chief markets are the countries where the Indians have settled in large numbers The most valuable markets are South and East Africa, Iraq, Persia and Ceylon Bombay does the largest export trade

In 1955, we exported 836 million yards of cotton cloth to foreign countries and 854 m yds in 1957 of which coarse cloth amounted to 176 6 million yds and 233 8 m yds, medium cloth 602 6 million yds, and 590.8 m yds fine 35.8 million yds. and 12.0 m. yds; and superfine 21 0 million yds. and 17 3 m yds The main varieties which we export consist of sheetings, long cloth, shirtings, coatings, voils, mulls and chintzes

In 1959, 816 million yds of cloth was exported to Foreign countries which was valued at Rs. 54 crores and in 1960 (Jan.

to Nov) 590 million yds. of cloth was exported, the value of which was Rs. 49 crores.

The Indian delegation to the World Textile Conference expressed India's desire to export 1,000 million yds. of cloth per annum which target the Second Plan has accepted

Besides cloth, cotton twists and yarns are exported to Burma, Straits Settlement, Syria, Aden, Thailand, Iraq, Arabia, and other countries where Indian immigration is considerable.

There is a great future for this industry in India as the standard of living is rising At present the average of cotton cloth in India works out at about 12 yards per head This is very low when compared with 64 yards which is the average for U S A To raise the consumption of cloth to any decent figure in India will require a tremendous growth of the industry and at the same time the purchasing power of the people.

The problem of raw cotton supply is a new problem which faces this industry due to the partition of the country The amount of raw cotton produced in the Indian Union is not enough for the home needs Raw cotton has, therefore, to be imported from Pakistan and other countries The following table shows the consumption of raw cotton in Indian Mills .—

In million bales of 400 lbs each

	Indian Cotton	Foreign Cotton	Total
1946-47	2 4	1 72	3 86
1948-49	2 12	1.13	4 25
1950-51	2.52	1 10	3 63
1952-53	3 61	0 85	4 46
1953-54	3.89	0 72	4 61
1954-55	4.14	0 63	4 77
1955-56	4 37	0 60	4 97
1957	4 69	0 56	5 26
1958	4 44	0 52	4 96

Cotton mills at present suffer from the following difficulties —

(i) Though the Post-War Planning Committee estimated that the optimum size for a composite mill is 25,000 spindles and 600 looms, but unfortunately a large number of composite mills as well as spinning mills are below the economic size According to the estimates of the working party on cotton mill industry some 150 mills are uncommercial

(ii) A large number of mills have worn-out and have obsolete machinery. The Bombay Millowners' Association estimated that nearly 90% of the machinery

in Bombay mills is more than 25 years old Hence, the existing mills should be brought to the economic size and the machinery and technical equipment should be renovated and modernized.

(iii) In spite of growth of industries in other parts of the country such as Madras, M P., U P, the industry still continues to be concentrated in Bombay where 60% of the existing spindles and looms are installed Hence, mills should be properly located

Features of Export trade

The important features in our exports of cotton textiles are ·

(a) About 90 to 92 per cent of our total exports consists of coarse and medium counts of cloth,

(b) An overwhelming percentage of our total export of cloth is in the grey form which gets processed in the importing countries for purposes of re-export;

(c) A bulk of our exports are to countries in Asia and Africa;

(d) Comparatively very little percentage of our exports are in dyed or printed and in other processed forms

The Government of India have been earnest in promoting exports of textiles produced in this country and have already taken certain steps Some of the important steps taken are

1. Constitution of the Cotton Textiles Export Promotion Council for intensive study of market conditions abroad cotton textiles and to promote exports,
2. grant of rebate of excise duty on goods exported,
3. assistance to manufacturers and exporters in obtaining raw material required for producing goods meant for export in good time and at fair prices;
4. popularising of commercial arbitration for settlement of trade disputes,
5. introduction of quality control measures and inspection schemes in regard to textiles intended for export; and
6. participation in international exhibitions and maintenance of trade centres and commercial show-rooms at important centres of the world

Some further measures which are considered necessary to enable manufacturers to improve the quality of the fabrics produced are also being actively considered

COTTON HANDLOOM INDUSTRY

Hand-spinning and hand-weaving have been India's traditional village industries. The spinning wheel was being universally plied in most Indian homes Even today it is one of the important cottage industries of the country. According to the Fact Finding Committee, 1942, the number of weavers were about 2 4 millions besides about 3 6 million auxiliary workers; thus giving a total of 6 million weavers for undivided India, for 2 million working handlooms, and the value of handloom production was estimated at 72 80 crores of rupees Even after partition, handloom weaving industry is still an important industry, in fact the largest and the most widespread after agriculture This industry now provides employment to 14 million people and produces about one-third of the total production of cotton cloths and has about 23,26,000 handlooms The annual production is estimated to be 1,800 million yds of cloth

The yarn needed by the industry is supplied mostly by the mills. It is only weaving that is generally done in these small towns In some cases, however, yarn used is also handspun. Cotton is distributed to women-folk in the surrounding villages where it is spun and then brought to the town to be woven

With the improvement of the handloom in recent times, the equality of the goods produced on the looms has considerably improved. Such improved quality goods enter successfully into competition with mill products, and give employment to thousands of workers

In India both the coarse and finer qualities of goods are made by handlooms. Napkins, gauze, bandages, jaconet, bedsheets, table cloths, curtain cloths, bordered saries, and cloth of coarse type are usually produced on the handlooms One of the reasons why the hand woven cloth is more popular than machine-woven cloth is the variety of the patterns which can be produced on the hand-made article. Muslims wear plaids which are of infinite variety while borders are common on Hindu men's and figures on Hindu women's clothing Hand weaving supplies this demand in an endless selection of patterns.

The following table shows the cloth produced on the handlooms —

Production of cloth on hand looms

1950	805 m yds.	1954	1,318 m. yards
1951	850 ,,	1955	1,480 ,,
1952	1,109 ,,	1956	1,509 ,,
1953	1,200 ,,	1957 58	1,714 ,,
		1958-59	1,865 ,,

Important centres for the cotton handloom industry in India are Banaras, Gorakhpur, Tanda, Etawah in U P., Chanderi in M.P ; Nagpur, and Poona in Maharashtra; Bhagalpur in Bihar; Shantipur in Bengal, Kozhikhode, Madras, Madurai, Coimbatore and Karnatak in S. India; Govindgarh and Chomu in Rajasthan.

According to the estimates of the Village and Small Scale Industries Committee, the additional quantity produced in handlooms was as much as 17,000 million yds. by the end of 1960-61. It is proposed to increase the number of handlooms in the co-operative field from 1 million to 1 45 million by 1963-64 It is also proposed to introduce technical and other improvements, thus raising the production per unit from about 4 yds to about 8 yds. a day

The export of handloom cloth in 1953 amounted to more than 35 million yds valued at about Rs 5 23 crores. Ceylon was the most important importer of Indian handloom piecegoods importing 40% of the total Indian export of handloom cloth. Others were Malaya, Nigeria, Singapore, Aden, U.K , Sudan and Ethiopia and the U S.A.

JUTE INDUSTRY

After cotton textile industry the most important industry is jute. In 1959 there were 113 mills. The Industry has a capital of 65 3 crores and gave employment to 271,415 persons. This industry is still predominantly localized in West Bengal It is particularly striking to note that raw jute which is the chief raw material of this industry is a "pure raw material" as it imparts its full weight to the finished product The loss of weight in the process of manufacture is almost negligible, in fact much less than in the case of raw cotton. The location of industrial unit need not be near the sources of raw material Nevertheless, the excessive concentration of the jute mill industry in the Hooghly Riverian can be attributed to the combination of various factors :—

(i) Bengal occupies a unique and unrivalled position as producer of raw cotton jute, for it accounts for 90% of India's output of raw jute The rich alluvial soil and the humid climate of Mymensingh, Tiperrah

and Faridpur are exceptionally suited for the production of raw jute

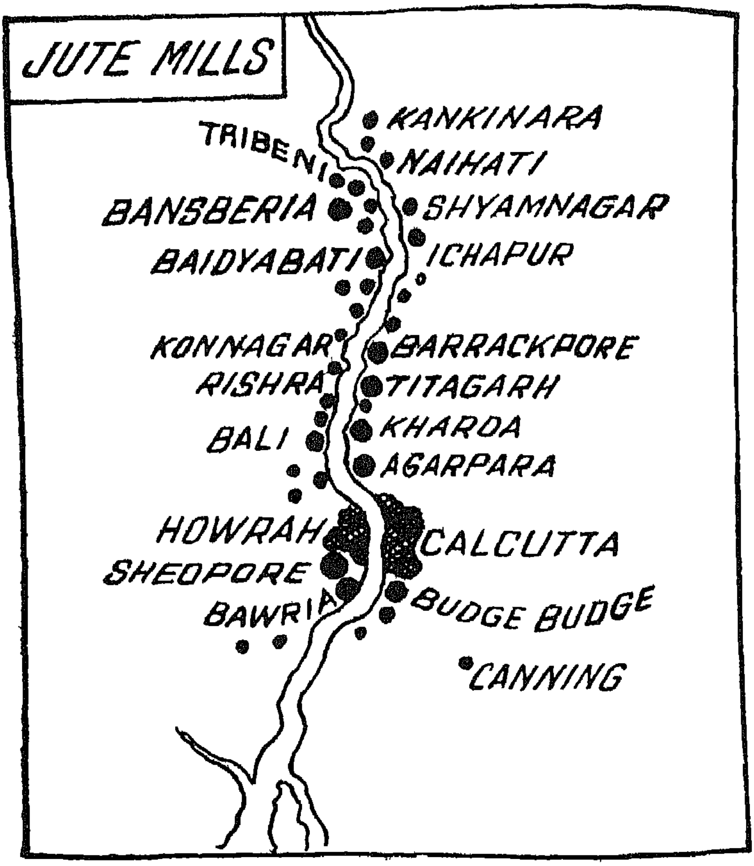


Fig 46. Location of Jute Mills along Hooghly River

(ii) The net-work of waterways, which connect the mos important jute-growing regions of West Bengal, offer favourable facilities for assemblage and transportation of raw jute from centres of production to centres of manufacture The Ganga, the Brahmaputra, the Meghna along with their tributaries provide the cheapest form of transport for the movement of jute fibre from fields to the factories

(iii) The proximity of coal deposits has been a material consideration—as it can be cheaply had from mines

of West Bengal and Orissa, etc The distance of Raniganj and Asansol coalfields is only about 120 miles

(iv) The earlier concentration of the industry in and around Calcutta could be ascribed to the availability of British, mainly Scottish enterprise and capital—both of which played a very great part in the development and expansion of jute mill industry.

(v) The insular position of Calcutta offered additional advantages to the jute industry in regard to foreign markets Besides, mill stores could also be imported from abroad easily

(vi) It is worth noting that Bengal did not provide necessary labour for the jute industry It was drafted from Bihar, Orissa, U.P., and even from Madras As early as 1906 two-thirds of the employees in the jute mills were immigrants and nearly 90% of the labour was imported

(vii) Humid climate necessary for jute manufacture is also the characteristic of the Hooghly basin

Thus it will be observed that because of the above factors jute industry is highly localized in a small strip of land measuring 60 miles in length and two miles in breadth lying along the bank of river Hooghly, above and below Calcutta—from Tribeni (30 miles above Calcutta) to Uluberia (20 miles below) on the north bank of the river and from Halishahr (28 miles above) to Birlapur (22 miles below Calcutta) on the south bank This small tract of land accounts for more than 90% of the total manufacturing capacity of the industry The greatest concentration lies within a 15-mile belt extending from Rishra on the north bank to Naihati in the south The important centres of the industry are Bally, Agarpara, Rishra, Titagarh, Serampore, Budge-Budge, Sibpur, Salkia, Howrah, Shyamnagar, Bansbaria, Kankinara, Uluberia, etc

It is interesting to note the absence of jute mills in the principal jute-growing belt of E Bengal (E Pakistan) The important reason for it is the peculiar character of the transportational system which entails several transhipment hurdles The three important districts growing jute are Mymensingh, Dacca and Tippera—all lie on the opposite bank of Brahmaputra river which is unbridged, and the transport across the river involves the problem of transhipment All raw-jute thus moving to Calcutta on the Dacca section has to be transferred to flats either at Jagannathganj or Narayanganj and loaded on wagons again at Serajganj and Khulna respectively Had the mills been located in the principal jute-growing belt, the transhipment hurdles had to be undergone twice, once in moving

the coal, mill stores, labour, etc , to the mills and then again, in moving the finished goods to Calcutta for export to consumers' markets overseas and to Indian States

For some time past there has been a slight dispersion of the jute industry This may be attributed to increasing demand for goods in U.P., Bihar after the rapid development of the sugar industry, and secondly, to the availability of many local fibres suitable for jute manufacture in Madras, U.P , and Bihar Hence four jute mills have been established in Madras and Andhra (at Chitwalshah and Naulimarlla) and three in Bihar and Orissa (at Darbhanga and Purnea) and two in U P (at Kanpur and Sahjanwan) and one in Madhya Pradesh It is felt that further dispersal of the industry is possible by encouraging the cultivation of jute in other areas of India

The geographical distribution of the Jute Mill industry in India is as follows —

Location of Jute Industry

State	No of Mills	No. of looms H & S.	Others	Total
West Bengal	102	65,785	3,788	69,573
Bihar	3	1,005	.	1,005
Andhra	4	1,052	42	1,094
U P	3	891	.	891
M P	1	220	.	220
Total	113	68,953	3,830	72,783

In 1959, there were 113 jute mills, of which 102 were in Bengal, 3 in U P., 3 in Bihar, 4 in Andhra and 1 in M P The total number of looms were 72,783 of which about 201,050 were for hessian and the rest for sacking

India has the largest jute manufacturing industry in the world as the following table shows —

World Distribution of Jute Looms (1956)

Country	Looms (000)	World%
India	68 4	57
Germany	9 6	8
Great Britain	8 5	7 1
France	7 0	5 8
Italy	5 0	4 1
Belgium	3.0	2.5
North America	2.7	2 3
South America	6.0	5 0

Jute Production and Exports

The most important manufactures of jute mills are gunny bags, for packing rice, jute, wheat and oilseeds, hessian cloth or bags used for baling, cotton, wool and other fibres, coarse carpets and rugs, twines, cordage and ropes The following table shows the production of manufacture for recent years

Jute manufacture (in '000 tons)

Year	Hessian	Sacking	Other	Total
1951-52	309	607	24 8	945 2
1952-53	348	510	33.0	892
1953-54	390	445	30 0	865
1954-55	399	557	38.1	995
1956	415 2	605 5	72.1	1092 8
1957	414 3	548 7	66.9	1029 9
1958 59	449	510	85	1041

July to June

In 1960, 10 85 lakh tons and in 1961 9.7 lakh tons of jute goods were manufactured in India In 1962 (Jan. to Sep) the production of jute goods was 8 9 lakh tonnes

Among the various problems facing the jute industry in India is its dependence upon raw jute from East Pakistan The Indian jute industry requires nearly 7 million bales of raw jute per annum if all the mills work to full capacity But India produced only 1½ million bales of jute in 1947-48, 2 million bales in 1948-49; 3 million bales in 1949-50 and 3¼ million bales in 1950-51 In 1954-55 the internal output of raw jute was 2 9 million bales and this along with imports of 1 2 million bales from Pakistan gave an inadequate supply of raw jute to India Hence, efforts have been made to increase the production of more jute in U P, Bihar, Madhya Pradesh, Orissa and Kerala

Under the Third Five Year Plan the output of jute manufactures has been proposed to increase from 10.65 lakh tons to 11 lakh tons.

Unlike cotton industry the jute industry of India is essentially an export industry It is a dollar-earning industry The following table gives the figures of jute exports from India

Year	('000 tons)	Gunny Bags (Value in Lakh Rs)	('000 tons)	Gunny cloth (Value in Lakh Rs.)
1950-51	345	5,539	266	5,291
1951-52	473	13,529	287	12 458
1952-53	371	6,139	304	4,024
1953-54	354	4,024	389	6,943
1954-55	451	5,685	360	6,251
1955-56	452	5,419	362	5,908

Our exports of jute manufactures consist mainly of jute cloth, jute bags and twist and yarn. The important buyers of jute bags are U S A , Cuba, Australia, China, U K and Argentina. Jute cloth is exported to U.K , Canada, U S A and Argentina while there is a considerable demand for twills in Egypt, Levant, South America and South and West Africa

As the foreign trade or the inland trade of the world increases the demand for jute products for packing also increases Many countries in the world, therefore, attempt to grow some substitute commodity for jute. In North America, U S A., Sweden, S Africa and Australia Kraft paper bags and cloth have been used for this purpose But no fibre satisfies the double requirement of cheapness and strength that the jute fibre possesses

One such substitute is the *'sisal'* grown in East Africa and other parts of the world It is thought that the quality of the *'sisal'* has been considerably improved recently to make it suitable for producing bags A feature of the recent growth of industrialism in South America is the attention which the various governments are giving to the use of indigenous fibres for manufacturing purposes. In view of the large variety of fibre plants which are to be found in South America what is happening there is but natural Brazil and Ecuador are well placed for the expansion of industries concerned with sack and bog making In Brazil, special attention is being given to the possibilities of *'caroa'*, which is indigenous to the country Its leaves reach a length of from 5 to 6 feet, each plan having three or four usable leaves which produce on an average 25 grammes of dry fibre. The distribution of the *'caroa'*, plant in Brazil is very extensive It is abundant in the valley of the River San Francisco and in the sandy portion of Pernambuco, Ceara and Bahia It is claimed that this Brazilian fibre is better than Indian jute for bag making The points emphasized in favour of *'caroa'* are that it is naturally white, that there is no necessity for it to be carded and emultioned before being spun and that the longer the spindle the better. It is also claimed that the strength of *'caroa'* is sixty times that of jute

Newzealand has introduced *Phormium* Tenax, Russia and Argentina use linseed fibre, other natural substitutes are Manila hemp Bow-string hemp, Kenof; Bimli jute, Bombay hemp; Julital etc.

The jute industry of India has profited much from wars in the past. Thus, the Crimean War and the American Civil War brought prosperity and opportunities for expansion, while the two Great Wars created an unprecedented demand in this industry The trench warfare which prevailed in the wars needed millions of bags In the second World War also, there was a

large demand for sand bags for A.R P work The second World War, however, used fewer bags than the first World War.

Problems of the Jute Industry

The main problems facing the Indian jute industry might be stated as follows:

1 To secure its raw jute supplies by increased production of jute within the Indian Union, with self-sufficiency as the goal, in addition, to improve the quality of the jute grown in India so as to bring it up to the general standard obtainable in the jute growing areas of Pakistan,

2 To rationalise the industry's production techniques by installing up-to-date plant and machinery, by taking advantage of the latest developments in jute technology, and by concentrating the manufacturing potential in the more efficient, modernised units,

3 With the aid of the measures referred to under (1) and (2), to reduce costs and stabilise prices at levels attractive to overseas consumers,

4 In conjunction with the foregoing, to pursue an energetic export promotion programme with a view to capturing lost markets and maintaining and expanding existing markets; and

5 To diversify the pattern of the industry's production and to seek new uses for jute

Owing to the shortage and fall in the production of raw jute and tremendous fluctuations in prices, the industry has been in an uncomfortable state for the last several years It was only in 1961-62 that relief to the industry was felt when raw material became plentiful and level of demand became high and prices were stable. The 1962-63 season was also expected to be good

In order to encourage modernisation, licences for the import of machinery have been liberally granted to the jute mills in the country and loans are also being offered through the National Industrial Development Corporation (NIDC) for modernisation of equipments.

Despite the very great handicaps imposed by various factors already mentioned, the Indian jute industry has made remarkable progress in the pursuit of these five major objectives and has thus once again demonstrated its fundamental solidarity, its resilience, its flexibility, and its very high organisational abilities

WOOLLEN INDUSTRY

The Woollen Industry in India is not an important one. The hot climate of the country over the greater part stands in the way of a large demand for woollen goods. The home supply of raw wool is also very inadequate.

There were 60 large scale and 75 small scale units in India in 1959 which were busy with the production of woollen goods. Out of them 106 were in Punjab, 14 in old Bombay State (now Maharashtra and Gujarat), 5 in U.P, 4 in West Bengal, 3 in Mysore, and 1 each in Delhi, Kashmir, and M P. The total labour employed in the industry in 1959 was about 18,712

These mills in India work mostly imported raw material and cater for the needs of the towns mainly. Kanpur, Dhariwal, Ahmedabad, Ludhiana, Bombay, and Bangalore are the important centres of this industry Kanpur has the distinction of having the largest woollen mill (Lal-imli) in Asia Indian wool is roughly classified as: (i) Hill wools used in the manufacture of blankets, tweeds, over-coatings and lower quality of woollen shawls, (ii) *Plain wools* both of coarse and fine type; coarse-type is used for low grade blankets and rug and fine type for better class of blankets, woollen broad cloths, tweeds and good grade carpets The Indian consumption of raw wool is about 24 million lbs a year.

The major expansion in the woollen industry took place between 1919-20 and 1950 as would be clear from the following —

	Capacity in 1946	Capacity in 1956
Woollen Spindles	50,000	60,979
Worsted Spindles	37,500	117,359
Power looms	2,300	4,042

Woollen handloom industry is widely established throughout the country 75% of the industry is concentrated in the colder parts of India, *viz* U P, Punjab, Rajasthan and Kashmir. This section of industry produces a wide range of products—blankets, durries, carpets, tweeds, Shawls, lohis, coatings, pattees, scarfs, etc There is also some production on a lesser scale of knitted goods, *e.g.*, socks, jerseys and pullovers. Certain goods have a considerable market in the country as well as abroad—such as Kashmir shawls, carpets and namdas, carpets from Mirzapur and Amritsar and druggets from Mysore and Bellary. The mill production of woollen goods in recent years is given below :—

Woollen Worsted Fabrics

(in million metres)

1950	11 1
1955	12.4
1961	13.2
1962	13.5
(First three quarters)	

In 1961 the production of woollen and worsted fabrics was 13 2 million metres and in the first three quarters of 1962 the production rose to 13 5 million metres. By the end of the Third Five-Year Plan the production is proposed to be raised to 31 85 million metres (35 million yds).

Indian manufactured wool in the form of carpets, rugs, piece-goods and shawls are exported to U S. A , U. K., Canada and Australia During 1955-56 we exported 9 6 million lbs. of carpets and rugs valued at 3 9 crores of rupees.

SUGAR INDUSTRY

India is the third largest producer of canesugar in the world, as would be clear from the following table —

World Production of Cane Sugar in 1958

(In '000 metric tons)

Cuba	5961	Australia	1438
Brazil	3590	S. Africa	1030
India	2450	Mexico	1368

The country had 5942000 acres under cultivation in 1961-62. The yield per acre in India is 14 to 15 tons, compares unfavourably with the yields of 62 tons in Hawaii and 56 tons in Indonesia. It is India's second largest industry next only to textiles

In 1959 the industry gave employment to 140000 skilled and unskilled labours and 3600 university educated men.

In 1959 the total value of sugar amounted to Rs. 190 crores.

LOCATION OF THE INDUSTRY

Sugar industry for its existence depends upon agriculture for its raw material—the sugarcane, which is greatly a 'weight-losing material' as the sugar produced from it ranges from 9 to 12% of the total weight of the cane used The cane is more difficult to transport than sugar and its sucrose contents begin to deteriorate after it has been cut from the field and better recovery is dependent upon its being crushed within 24 hours

of its separation from the root. In Weberian terminology the sugar industry has a 'material index' of greater than unity, and hence, the industry is not capable of considerable dispersion. Besides, the price of sugarcane constitutes 52 58% of the total cost of white sugar. The factor makes the sugar manufacture a 'raw material-localized' industry and as the local distribution of sugar-cane is more or less entirely dependent on climate and rainfall Nature plays a decisive role in the location of this industry

At present the sugar industry is predominantly localized in the two states of U P and Bihar, which together account for over 70% of the productive capacity in the industry and employ a little less than three-fourths of the total number of workers employed in the industry These two states had the advantage of an early start The earliest attempts to start the sugar mills in north Bihar was made by the Dutch planters in 1841-42 and by the English planters in 1899 In spite of the failure of these early attempts the sugar industry came to be established on a sound footing in this region as early as 1903 So that by 1931-32, out of 31 sugar factories in the whole of India 14 were in U P and 12 in Bihar. This number increased to 67 in U P , and 29 in Bihar in 1950-51, and to 68 in U P and 28 in Bihar in 1956-57, and to 70 in U P and 28 in Bihar in 1959 Out of a total of 163 factories Maharastra and Gujarat had 27, Andhra 11, Madras 5, Punjab 6, Mysore 6, M P 5, Rajasthan 2 and Kerala, Orissa, W Bengal and Assam 1 each The excessive concentration of the sugar industry in these two States of U P and Bihar can be attributed to the following factors —

(1) More than 90% of the sugarcane acreage lies in Northern India in the Gangetic plain which possesses rich and fertile alluvial soil brought down by the mighty rivers like Jamuna and Ganga This soil contains adequate quantities of lime and potash so very necessary for the cultivation of cane Besides the loamy soils found in some regions are exeptionally suited for cane cultivation.

(2) The plain has a level surface, and this factor enables the region to enjoy the facilities of irrigation of the crop. The concentration of sugarcane crop in compact blocks also enables the sugar factories to get fresh cane-supplies direct from the fields.

(3) In case of most of the factory industries, the source of power is an important consideration ,and therefore, in establishing such factories the question of the supply of fuel or electricity always plays an important part in the choice of their location But the sugar industry is entirely independent of the supplies of coal or electricity for running the machinery, because

the bagasse obtained as a by-product is more than enough to meet the entire requirements of the mills for raising the steam to drive the machinery and no supply of fuel from outside is needed

(4) Being nearer to the consuming markets, these states enjoy the advantages of cheap transport of sugar to these consuming centres

(5) The States of U P and Bihar are thickly populated and hence large amount of labour supply—though inefficient—is available cheaply

(6) Water for factory purposes is abundantly available from numerous canals and rivers flowing in these regions as well as the tube-wells

A fortuitous combination of all the above advantages is thus responsible for the localization of sugar industry in U P. and Bihar The most important centres of productivity are Kanpur, Meerut, Pilibhit, Lucknow, Gorakhpur, Allahabad, the districts of Meerut, Gorakhpur and Rohilkhand division, and—Bhagalpur, Saran, Champaran, Muzaffarpur in the districts of Saran and Champaran in Bihar

For some time past, the tendency of the dispersal of the sugar industry is noticeable in newer areas especially in Madras, Bombay, Bengal and Andhra Many of these states enjoy exceptional natural advantages for the cultivation of sugar-cane The first two states, being entirely tropical, are climatically best suited for superior varieties of cane The thick canes of southern India are rich in sucrose content, less than 10 maunds of sugar-cane is enough to produce a maund of sugar The average yield of cane and sugar per acre in Bombay is 40 and 3 tons respectively In exceptional cases in Bombay Deccan an yield of 100 tons of cane and 11 tons of sugar per acre has been obtained In the sub-tropical north nearly 11 to 13 mds of cane is required to give 1 md of sugar The average yield of cane varies from 12 to 18 tons per acre and the output of sugar per acre is estimated between 0 7 and 1.5 tons.

Besides the crushing season of sugarcane in Bombay and Madras is of much longer duration than that of U P and Bihar. According to the report of the Tariff Board (1938) the average of the actual number of working days of the central sugar factories for three years for the tropical region was 132 days as against 128 days for the sub-tropical region[1] The following table showing the monthly average cane crushings based on the quantities of cane crushed in the typical factories, gives a fair idea of the crushing season in different parts of the country.[2]

1 Report of the Indian Tariff Board on Sugar (1938), p 61
2 Report of the Marketing of Sugar in India (1943), p 93.

%Of the Cane crushed in different Months

Months	Sub-tropical Regions					Tropical Regions		
	Punjab	Western U P	Eastern U P	Bihar	Bengal	Bombay (now Maharashtra) and Gujarat	Madras	Mysore
October	..					6 8		9 6
November	13 5	10 7	2 2	2 8	1 6	12 3	1 4	11.7
December	26 5	22 1	19.7	19 4	23 5	15 9	3.2	6.2
January	28 1	22 7	28 2	22 2	26.2	15 4	17.1	5 5
February	18.7	19.5	20 1	21 0	21 6	14 6	22.4	11 2
March	13 2	19 9	19 7	20.9	16 8	15 1	24 0	12 0
April		7 8	9 5	8.2	8 7	12 3	18 8	10 7
May		1 3	0 6	5.5	1 6	6.8	12 8	9.8
June to Sept						0 3	0 3	23 3
Total	100	100	100	100	100	00	100	100

Coupled with the advantages of tropical climate best suited for the cultivation of super varieties of cane, the availability of irrigation facilities, the proximity of consumers' markets and excellent transport facilities, which the ports of Bombay and Madras command in relation to export markets, have placed these states in a very advantageous position for the further expansion of the industry But despite these natural advantages the industry has not made rapid progress here because: (1) In Madras, the progress of cane cultivation has been hindered by the availability of wide range of alternative cash crops—groundnuts, cotton, plantains, chillies and tobacco in addition to staple food crop—paddy—which is more paying[1] (2) Further the over-all cost of sugar manufacture is also very much higher in Bombay and Madras than U.P or Bihar In Bombay, the cost of cane-cultivation is much higher because of the cost of irrigation and the practice of heavy manuring,[2] (3) Moreover, in these states, the sugarcane is not grown in such concentrated and compact blocks as in U P or Bihar The mills, therefore, experience difficulty in getting their supplies of cane from within the reasonable distance.

In West Bengal, the industry is now making progress. Although, some districts possess ideal conditions of cane cultivation, yet the severe competition from alternative crops like

1 *The Location of Industry in India*, p 42.
2 *Report of the Tariff Board on Sugar Industry* (1938), p. 26-27.

rice and jute has prevented the expansion of sugar industry. Mysore and Madras have also developed the sugar industry. The sugar industry in these states has received great impetus from the completion of irrigation projects like the Erwin Canal in Mysore, the Nizamsagar and Tungbhadra projects in Andhra and Cauvery Mettur, and Periyar irrigation projects in Madras.

From the above analysis will be seen that the sugar industry is mainly concentrated in U P. and Bihar. The sugar interests in U P and Bihar have felt that the industry in these two states—which have been the home of the industry since 4th century B C—is placed in its most natural surroundings and as such, like jute in West Bengal, sugar has become identified with U.P and Bihar and so it will be unfair demand that sugar industry should be, more or less, limited to these two states. But it may be pointed out that an over-concentration of the sugar industry in U P and Bihar would necessarily mean heavy transportation charges over long distances and consequently considerable additions to the selling price of sugar. A dispersal of the industry in various regions, suitable for its growth and development would be, therefore, advantageous to both the consumers and the producers—since it is likely to reduce the selling price and to increase the demand for sugar. As Dr. R. Balkrishna has rightly suggested, "The future location of sugar factories must be such that they would be expected to cater to a market which is confined to a reasonable radius of distribution provided that no sugar factories are started in the areas where the costs of production are likely to be higher than the price at which the sugar produced in other regions can be sold there"

The following table shows the statewise distribution of the industry in 1958-59 —

States	No of factories working	No. of actual working days*	Sugar cane crushed ('000 tons)	Sugar produced ('000 tons)	Percentage of recovery of sugar
U P	70	147	9252	888	9 6
Bihar	28	134	3175	311	9.7
Bombay (old)	27	141	2678	320	11 9
Andhra	11	160	1279	120	9 3
Madras	5	164	856	70	8 1
Punjab	6	164	807	69	8 5
Assam	1		23	2	8 6

States	No of factories working	No. of actual working days*	Sugar cane crushed ('000 tons)	Sugar produced ('000 tons)	Percentage of recovery of sugar
M P	5	123	223	21	9 4
Mysore	6	229	817	85	10 4
Rajasthan	2	128	77	7	9 0
Kerala	1	136	133	11	8 2
Orissa	1	153	30	3	10 0
W. Bengal	1	140	70	7	10 0
Total	164	145	19420	1914	9 8

*1955-56

A survey of the sugar industry in India, in the light of the protection granted, is interesting. We shall survey both the manufacturing and agricultural aspects over a number of years. In 1917-18 the area under cane in India was approximately three million acres It fluctuated round this figure during the next fifteen years It was not until 1933-34 that there was a noticeable increase in acreage, coinciding with the policy of protection introduced Within the next four years the acreage figure exceeded four millions, and continued in the neighbourhood of this figure until the War Over three million acres of this are under improved quality cane yielding as much as 15½ tons, in comparison to about 12¼ tons per acre in 1930-31 It is clear that from the agricultural point of view the policy of protection given to the Indian Sugar Industry has done considerable good to the country. The cost of production of sugar in India, however, is high when compared with Java or other tropical areas where the cane yield is higher The most outstanding feature of the sugar industry in India is the **short** crushing season due to the hot, dry summers over the cane area The cane must be removed from the fields and crushed before this dry and hot season starts The crushing starts in December and ends in February In 1955 the factories worked for 145 days only

The effect of protection to sugar industry was marked in the number of new mills The very first year of protection witnessed a doubling of the number of factories operating in the country

This unprecedented increase, however, created certain difficulties for the industry Over-production and uneconomic internal competition became marked. In 1934, therefore, an Excise

Duty was imposed which slowed down the erection of new factories in favour of the extension of plant in existing factories. The sugar production in India increased at such a rate that in 1937-38 the net imports of sugar had fallen away to the comparatively insignificant figure of 22,000 tons—essentially of special qualities of sugar not manufactured by Indian factories—against a total consumption of approximately 12,000,000 tons. The sale price of sugar also came down from about Rs. 9|6 per maund to about Rs 6|9 per maund The conditions, however, have changed now In 1953 the Government changed its policy and imported foreign sugar

On account of the peculiarity of the climate in Northerr India, which limits the supply of cane to the factories only to a few months, from about December to March, the sugar factories have to remain idle for the greater part of the year. Even during this short crushing season, some factories are unable to get enough cane There is a tendency on the part of the factories, therefore, to acquire land near their sites cultivating sugarcane on modern lines This is an effort to copy Java and Cuba, etc. In India the sugar factories have to depend upon the cultivator for the supply of cane

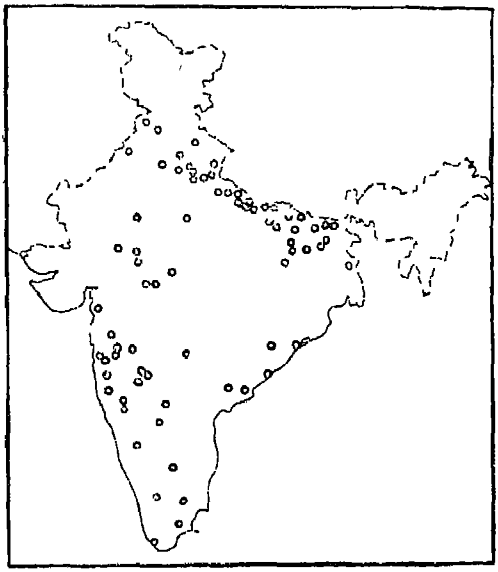


Fig. 47. Location of Sugar Mills in India

In Southern India crushing period is a longer one, as the hot, dry and scorching summer of the Indo-Gangetic plains is not felt there.

Most of the cane juice is water and is evaporated or drained off as molasses when sugar crystals are made from it. The total amount of sugar obtained from the cane is only about one-tenth of the weight of the cane. In Java and other tropical islands this is slightly more than in India, owing largely to the efficiency of the sugar mills In India, only 1 39 tons of sugar is recovered per acre, as against 6 48 in Hawaii; 5 07 in Peru· 6.44 in Indonesia, 3.65 in Philippines and 2 43 in S. Africa.

PRODUCTION

It has been estimated that approximately 55% of the total cane produced in India is utilized for the purpose of making *gur* and *khandsari*. Only 25 p c. goes to the mills for the manufacture of crystal sugar In India three types of sugar are made—Gur or jaggery, khandsari and white sugar (i) Of these the simplest is jaggery, being merely cane juice boiled and solidified Juice is boiled in open pans to solidify. (ii) Khandsari is made through an indigenous process by the molasses being separated from sucrose (iii) White sugar is directly produced in the factories in India.

In 1958-59 in India there were 164 working factories and 120 average working days Total amount of sugar cane crushed was 19420000 tons and sugar produced 1914000 tons In 1960-61 there were 175 sugar mills in India and the production of sugar was 30 29 lakh tonnes In 1961-62 the output was lower at 27 14 lakh tonnes which was largely on account of poor crop—

The consumption of sugar in India is lowest in the world We consume only 46 1 kg of sugar per head (1957) as against 54.8 kg in Australia and 51 kg, per year per head in Cuba; 44.4 in New Zealand, 42.0 kg, in Canada, 29.1 kg. in France, 51 5 kg in U.K and 54 1 kg in Denmark. In 1962 however, internal consumption showed an upward trend.

Under the Third Plan it is proposed to raise the production capacity to 35 lakh tons and production to 35 lakh tons at the end of 1965-66 (Plan period)

EXPORTS

In past, India depended on foreign countries for sugar and in 1929-30, we imported nearly 9½ lakh tons of sugar, but in recent years, as the sugar output has increased, imports are only nominal However, restricted exports of sugar to the extent of a few thousand tons per annum has been taking place to some of the neighbouring countries The chief difficulty in increasing exports is the high cost of Indian sugar As against

the ex-factory price of Rs 27 per md of sugar in India, the landed cost of sugar in most of the countries is Rs 21 to 23 per md The cost of sugar production is high in India because most of the factories are below the optimum size of 800 tons of cane-crushing capacity per day.

In 1957-58 we exported over 150000 tons of sugar. In 1962 the exports increased, amounting to 3 73 lakh tonnes.

BY-PRODUCTS OF SUGAR INDUSTRY

The three main by-products of sugar industry are bagasse, pressmud and molasses These are used as raw materials by a number of industries Bagasse is widely employed in the manufacture of paper pulp and card-board Wax is extracted from press-mud and molasses is used in the manufacture of aconitic acid, industrial and power alcohol, chemicals, tobacco, curing either chloroform, acetic acid, etc

POWER ALCOHOL

There are 44 distilleries in India which distil alcohol cane molasses Alcohol is available in three varieties It can be used as drink secondly it can be used for manufacture of a number of chemicals, and thirdly it can be used as a motor fuel, for the production of mechanical power known as power alcohol. There are at present 19 units equipped with necessary facilities for the production of power alcohol—with an average rated capacity of 12 839 million gallons of power alcohol and 3 948 million gallons of commercial alcohol Of these units 12 are in U P , 2 in Bihar, 1 in Andhra, 1 in Mysore, 1 in Bombay and 1 in the Punjab

The molasses can also be used as cattle fodder; for building road surfaces mixed with asphalt or bitumen and as manure

U. P. is the largest producer of molasses in the country as is evident from the following figures —

(Production in 000 tons) 1955-56

U P	3,813	West Bengal	43
Bihar	1,228	Orissa	27
Maharashtra and Gujarat	683	Mysore	187
Andhra	643	Madhya Pradesh	150
Madras	276	Kerala	36
Punjab	168	Rajasthan	59

The following table gives the productions of alcohol —

Years	Power	Rectified spirit	Denatured Spirit
		(In '000 gallons)	
1950	4,497.6	3,435.6	1,477 2
1951	5.809 2	5,019 6	1,966 8
1952	7,742 4	4,668 0	2,178.0
1953	8,120 4	4,376 4	2,493 6
1954	8,007 6	4,630 8	2,835 6
1955	10,432 8	5,156 4	2,889.2
1956	10 143.2	3,999 6	3,392 8
1957	10,136 4	5,064 0	3,439 2
1958	8,509 2	5,951 2	3,820 2
1959 (Jan to June)	4584 4	3756 0	2272 4

In 1960-61 the production of power and industrial alcohol was 22 million gallons The Third Five Year Plan targets for capacity and production of power and industrial alcohol has been kept at 72 and 60 million gallons respectively.

Paper Industry

The first paper mill was started in India about a century ago in 1867 on the. Hooghly river in West Bengal With the help of protection from 1925 to 1947, industry made steady progress, though slow. The paper industry today is one of the major industries It provided employment to 23,700 persons during 1957.

The number of paper mills in India at the beginning of 1951-52 was 17 with a capacity of 136,000 tons Early in 1960 there were 26 mills in India and the capacity of the mills at the end of Second Plan was 4 10 lakh tons The production of paper and paper-board in 1961 was 3 64 lakh tons and in 1962 it was 3 83 lakh metric tons (provisional)

The following table gives the progress of the industry —

Years	No of mills	Installed Capacity ('000 tons)	Total Production ('000 tons)
1913	5	34	27
1923	6	37	26
1937	10	N.A.	48
1950	16	114	109
1960	20	310	345
1961	26	418	364
1962	28	1168	383

Unlike the sugar and the cotton industries, the paper industry of India is handicapped for want of a large home market Owing to the backward state of education in the country, the consumption of paper in India is very little The following table compares the annual per head consumption of paper in some countries in 1961-62

U S A	439 5 lbs
Britain	235 0 ,,
Canada	280 0 ,,
Sweden	270.0 ,,
W Germany	179 0 ,,
Australia	195 0 ,,
Pakistan	3 0 ,,
India	2 5 ,,

Raw materials form the bulk of the requirements of this industry Roughly about 8 tons of these are required to produce 1 ton of paper Luckily India has a large supply of raw material necessary for a prosperous paper industry Most of this material has, however, fallen to the share of Pakistan The *Sabai* or the *Bhabar grass* is the staple material for paper making in India It closely resembles the Esparto grass of Africa which is so much in demand by the British paper industry The greatest drawback of the *Sabai grass* is that it grows in tufts intermixed with other vegetation and it is difficult to separate impurities from it Its supplies are also limited The supplies of bamboo, the other raw material of paper industry in India, are almost inexhaustible because of its quick and dense growth The regeneration of wood-pulp forests takes about sixty years, while the bamboo forest is ready in a year or two. The quality of paper produced from the bamboo, however, lacks in strength But the bamboo has an advantage over the *Sabai* in that the paper can be made entirely from bamboo without any admixture of woodpulp But the paper made from bamboo lack the bulking quality of *Sabai grass* paper and cannot so easily be used both for printing and for writing. On the other hand, both in finish and clearness of surface of writing it is greatly superior to grass paper, and does not compare unfavourably with the imported paper Though India does not produce paper from wood yet either because suitable wood does not grow in India, or it grows in inaccessible areas in the Himalayas, the recent discovery of methods for manufacturing paper from hard wood has made a revolution. New mills are being built to utilize the hard woods of Madhya Pradesh. For cheap varieties of paper

rag, hemp, jute waste and waste paper are also used But necessary chemicals—caustic soda, soda ash, salt cake, bleaching powder and dyes are to be imported from abroad

Most of the paper in India is produced in the neighbourhood of Calcutta which, with its large population, large number of presses and offices, offers the largest markets for paper Good quality paper is manufactured from imported wood pulp Wood pulp is also mixed with grass pulp to produce suitable paper The advantages enjoyed by the Bengal Mills are that they are very near coal supplies, large market and plenty of water from the Ganga They have, however, to get the raw material from long distances.

The following table gives the geographical distribution of existing paper mills in India·—

State	No of Mills	Important Centres
West Bengal	6	Kankinara, Titagaih, Raniganj, Bali, Naihati
Bombay (Gujarat & Maharashtra)	6	Bombay, Poona, Ahmedabad
U P	2	Lucknow, Saharanpur
Mysore	2	Bhadrawati
Punjab	2	Jagadhari, Ambala
Andhra	2	Rajahmundry, Sirpur.
Kerala	1	Punalur
M. P.	1	Nepanagar
Orissa	2	Brajrajnagar, Sambhalpur
Bihar	1	Dalmianagar
Madras	1	Pudu Kottai
	26	

The effect of protection afforded by the Government in 1925 to the paper industry in India has been good This can be seen from the fact that whereas in 1931-32 there were 8 paper mills producing about 40 thousand tons out of the total consumption of about 82 thousand tons in India, roughly about one-half, in 1936-37 there were 9 mills Their production was about 48 thousand tons out of the total of 113 thousand tons consumed in India, less than half The important point to note, however, is that before this latter year the Indian mills imported from abroad more than 53 percent of the raw material they used, while in this year they used only 23 percent imported raw material The rest of the raw material used in Indian mills was indigenous pulp The increase in production of 8 thousand tons over 1931-32 was all of paper in the protected class, whereas

the increase in imported paper was confined to unprotected classes Of significance is the development in the use of indigenous pulp, and principally bamboo pulp, which increased from 5 thousand tons to 19 thousand tons over the same period Grass pulp and other pulps, however, have increased only slightly. The protection was withdrawn in 1947 but the high revenue duty is still helpful to the industry In 1948-49 about 1 lakh tons of paper of all kinds was imported at a cost of about 12 crores of rupees The home production was also about 1 lakh tons. In 1952 the record production of 138,000 tons was made and in 1958 the production rose to 253,000 tons.

The production of paper and paper-board has seen further rise from 294000 tons in 1959 to 345000 tons in 1960, 364000 tons in 1961 and 383000 tons in 1962

For newspapers, in which mechanical paper is used, India is entirely dependent on import The Paper Pulp Section of the Forest Research Institute, Dehra Dun, is experimenting in this line It has found certain varieties of fir and spruce suitable for newsprint production The Madhya Pradesh Government has started the NEPA Mills at Chandni in which it has started manufacture of newsprint The wood of Salai tree is used for making the paper pulp It has an installed capacity of 30,000 tons, while the present annual demand is for 70,000 tons. Other ideal places for the location of mills for the manufacture of newsprint are Kashmir and Tehri Garhwal where fir and spruces in sufficient quantities are available

During the last some years the production of newsprint in India has been as given in the following table —

Year	Production ('000 tons)
1955-56	3.45
1957-58	14 14
1959-60	22 41
1960-61	23-40

Recently licences have been given for starting 7 new mills, whose installed capacity would be of the order of 551,000 tons per annum. Of these 3 mills are to be located in Bombay and 1 each in Andhra, Bengal, Assam and Orissa Licences have also been granted for the expansion of the existing 8 mills, so as to increase their capacity to 109,500 tons annually

Under the Third Plan the productive capacity of paper and paper board industry is expected to go up from 4 1 lakh tons to 8 2 lakh tons and production from 3 5 lakh tons to 7 0 lakh tons The productive capacity of newsprint industry will rise from 30,000 tons to 150,000 tons and the production is expected

to rise from 25,000 tons to 120,000 tons For this purpose three units have been sanctioned.

The noteworthy feature of the paper manufacturing industry of India has been the manufacture of almost all varieties of paper The types of paper manufactured in India are white and unbleached printing other than newsprinting, writing paper, and envelopes, packing papers, pulp board, coloured printing paper, etc The production of certain types is clear from the following table —

Production of Paper (in '1000 tons)

		1947	1950	1952	1954	1955	1957	1958	(Jan to June) 1959
1	Printing and writing	53	70	91	102	119	127	155	78
2	Wrapping paper	17	15	22	24	28	38	40	23
3	Special Varieties	5	5	3	5	6	7	6	2
4	Boards	18	19	22	14	31	38	51	25
	Total	93	109	138	115	184	310	253	128

Besides home production, India also imports various kinds of paper from U K, Norway, Sweden, Germany, Japan and Holland

Jan to June 1959
78
23
2
25
128

The imports of paper and paper-board into India in recent years has been as follows —

1957	21 lakh cwt.
1958	14 5 „ „
1959 (Jan to July)	10 3 „ „

The imports of newsprint into India in 1957, 1958 and 1959 (Jan to July) were 63,750 tons, 57,470 tons, and 41,704 tons respectively

The export of paper from India has been negligible She exported paper to the tune of 40178 cwt in 1958

MATCH INDUSTRY

There are 44 match factories in India with a capital investment of Rs 4 07 crores, with an installed capacity of 800,000 cases of 50 gross of 144 boxes each. Match industry in India employs about 16,000 people. No country in the world can be said to be self-sufficient in all, or even most, of the raw materials of the match industry Labour[1] accounts for the largest share of the cost of production of matches in India. India, with its teeming millions is, therefore, in a favourable position as regards the match industry It has the advantage, not only of cheap labour, but also of a vast home market The chief disadvantage is in respect of wood Suitable wood grows in India, scattered here and there, or in insufficient quantities Most of the Indian wood used comes from Andamans or the Sunderbans Match-wood logs must be obtained with the bark unremoved so that the wood may not dry. They may also be cylindrical and for this reason occupy more space The cost of transport is, therefore, necessarily high.

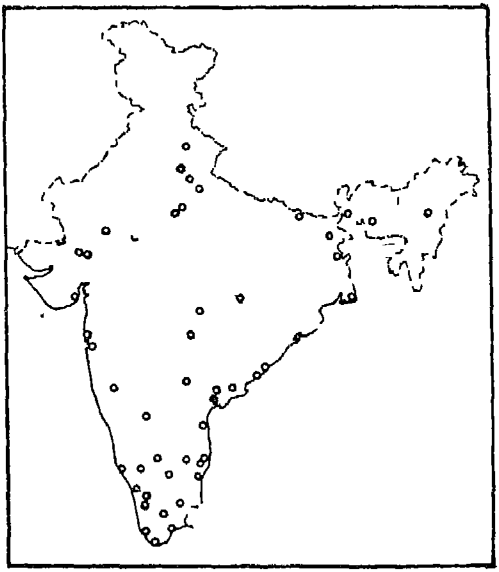


Fig 48 Location of Match Factories

1 The Indian Tariff Board Report, 1928, gives the most important items of cost of producing one gross as follows —

Labour 5 annas, wood 3 annas, chemical 1 anna, others 5 annas Most important chemicals used are Chlorate, Potash, Paraffin and Amorphus. Sulphur is a very minor item

Wood cannot be extracted from the Indian forests during the Monsoons Heavy stocks must, therefore, be stored by the factories The stocks are attacked by the borers in the store and cause much loss. Large quantities of aspen wood are imported from abroad, especially Finland and Russia, in Bombay where suitable Indian wood is not easy to get.

The largest production of matches is in the neighbourhood of Calcutta where Indian wood is mostly used. The Indian wood in use in Calcutta *genwa,* though *papita* and *dhup* from the Andamans are also used; *didu* and *bakota* also come from the Andamans. *Genwa* is available in large quantities in the Sunderbans The next important centre for the industry is Bombay where the wood is imported But there are some factories in Gujarat and other parts of Bombay where Indian woods are used These woods are *simul,* mango and *salai.* These woods do not grow in large quantities at one place Plantations of *simul* have now been undertaken by some factories *Simul* is very good for box-wood, but is inferior for sticks. In fact, there is no Indian wood, except perhaps the mango, which is as good for splints as the imported aspen The chief centres of this industry are Bareilly, Gwalior, Hyderabad, Ahmedabad, Ambarnath, Calcutta, Madras, Shimoga, Petlad, Dhubri and Trivandrum

The total amount of matches produced in India in 1958 was 614,000 each containing 50 gross boxes of 60 sticks each The production is increasing under the protection of Government. The imports of matches have now practically ceased. The Swedish Match Industry which was the greatest supplier of matches to India has built its own factories here and imports most of the raw material from Sweden or Finland.

The production of match in India was —

1950	523,200 cases	1955	615,600 cases
1951	578,400 ,,	1956	589,000 ,,
1952	619,200 ,,	1957	577,000 ,,
1953	618,000 ,,	1958	614,400 ,,
1954	529,200 ,,		

GLASS INDUSTRY

Glass making on modern lines is of very recent origin in India It was only during the first World War that the real progress in this industry was made. Glass industry employs today about 26,000 people annually and the total amount of capital invested is Rs 12 crores, and the product is estimated to the value of Rs. 16 to 18 crores annually. There is a considerable home market and some of the raw materials are easily available. By far the most important raw material is the silic sand

Sands of a degree of purity requisite for glass making are found at several places in India At Mangai-Hat and Patra-ghatta, in the Rajmahal hills, there occur white Damudas and stones, which after crushing, washing and sieving, yield sand from which ordinary quality glass can be made From Lohagra and Bargarh near Allahabad a suitable sand is obtained by crushing and grading a Vindhyan quartzite Good quality sand can be obtained from sandstone at Sankheda and from the Sabarmati river sand at Pedhamli, both near Baroda Sands of suitable quality also occur at Jabalpur The sands found at Bargarh and Lohagra are used by most of the factories. In addition, sands from Jejon Doaba in the Hoshiarpur district and from Sawai Madhopur in Jaipur State are also used by some factories Suitable sand also occurs in Mysore State.

Among the chemicals used, the Soda ash sulphur and manganese oxide are exclusively imported from U K and U S A. Refractory materials for the furnaces and coal for firing the furnaces are available in India. A cheap supply of coal is of a great importance The choice of the raw materials for glass making is a matter of great importance as the quality of the finished product depends very largely on the purity of the material used Suitable major raw materials are available in India, but the important consideration is the location of the factory, so that these materials may be brought together cheaply Borax has also to be imported but dolomite, saltpetre and lime, stone are found in large quantities in the country

In addition to the manufacture of glass by modern methods, there is also the indigenous glass industry for making bangles from the inferior varieties of glass This glass is manufactured from the impure sands of the rivers and the eflorescent alkali salts of the *reh*, commonly found in many parts of India.

There are 131 registered glass factories (excluding 100 bangle units) in India Out of the total number of factories in 1958 only 84 were actually engaged in production, 25 had been temporarily closed down and 22 more or less permanently. In November 1956 the statewise distribution of factories was as follows —

State	No of units
W Bengal	28
U P.	24
Madras	9
Bihar	8
Punjab	3
Delhi	3

Rajasthan	2
Gujarat & Maharashtra . ..	18
M P	5
Andhra Pradesh	2
Mysore	2
Other states	5
	109

The Indian glass industry may be divided into two categories· (i) the cottage industry making mainly glass bangles in small furnaces from glass blocks produced in factories, (ii) Modern factory industry.

(i) Cottage Industry is, though spread over different parts, mainly concentrated in Ferozabad district of U P and the Belgaum district of Maharashtra At Ferozabad bangles of all types are made and these supply nearly one-third of India's demand This industry is localised here because of the availability of good sand, saltpetre in the neighbouring areas and the skilled artisans—sisgars who have been doing this job for about a Century Coal is obtained from Bihar.

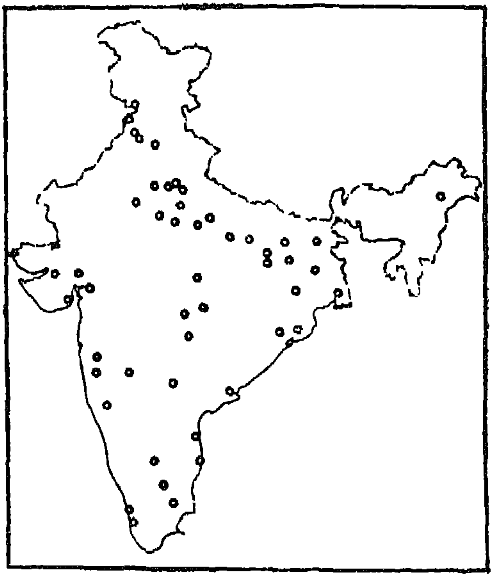


Fig. 49 Location of Glass Industry

(ii) The factory industry is mostly confined to U.P., Bombay, West Bengal and the Punjab and Bihar.

In U.P. there are about 34 factories which manufacture glass-sheets, pressed and hollow wares Bahjoi is the important glass-sheet making centre in India. Hollow and pressed wares such as motor-head-lights, reflectors, chimneys and bulbs, are manufactured at Hathras, Naini, Bahjoi and Shikohabad. The chief factors favouring the location of this industry in U P. have been the abundance of good-quality sand, potash, nitrate and lime in the state, but coal has to be got from Bihar The glasswares of U. P have country-wide market but the industry suffers from two main defects, *viz.*, that the workers are often unorganised and secondly, the designs, etc, are a bit old fashioned

In Bombay and West Bengal—at Telegaon, (Bombay) and Calcutta—factories generally produce bottles, lampwares, glass tubes, flasks, test tubes, beakers and flat glass.

In the Punjab factories at Amritsar and Ambala produce hollow wares and scientific and precision goods.

The Indian factories usually produce glass cakes for bangles; heads, bottles, phials, tablewares and lampwares; sheet and plate glass, and surgical and laboratory requirements in glass Recently the manufacture of thermal flask, and glass-tubes have also begun

The following table gives the production of glass and glasswares in India for recent years.—

	1950	1955	1957	1958	June to July 1959
1. Sheet glass (000. sq ft)	9,570	38,883.6	48,306	72,112	45,160
2. Laboratory glass (tons)	2,160	2,498	3,096	3,908	3,003
3. Glass shells for electric lamps (lakh pieces)	129.6	260 4	391 2	301 4	205
4. Other glassware (tons)	27,216	1,00,008	1,23,948	3,17,364	276,352

Under the Third Plan, the annual capacity and production of glass and glasswares is expected to increase from 3 7 and 2 25 lakh tons in 1960-61 respectively to 6 15 and 4 4 lakh tons in 1965-66 respectively. The imports of glass and glasswares in 1958 valued at Rs 58 29 lakhs and in 1959 (Jan to July) at Rs 35 73 lakhs The value of exports was Rs 20 30 lakhs in 1958 and Rs 11 73 lakhs in 1959 (Jan. to July)

CEMENT INDUSTRY

The manufacture of cement also is of recent development in India. The increasing home market due to increased activity in building trades and new uses of concrete have led to considerable expansion

Cement is usually produced by the action of intense heat on a finely powdered mixture of limestone or marl with clay or shale The mixture should contain about three-fourths of calcium carbonate and about one-fourth of clay material, with a little gypsum * In India some of the limestones contain all the ingredients in almost correct proportions At Banmore (Gwalior Portland Cement Co) the limestone so nearly contains the necessary things that very little clay has to be added. At Lakheri (Bundi Portland Cement Co) no clay at all is used, the correct proportion being obtained by mixing different grades of limestone In other cases substantial amounts of clay have to be added. The proportion of gypsum necessary is about 5 per cent.

Abundant supplies of limestone of excellent quality exist in many parts of the country close to the railway, so that the cement factories have usually been established near the quarries Suitable clay is invariably found close to the factory Gypsum is produced in India but has to be brought from long distances at high cost of transport Counter-balancing these natural advantages, almost all the cement factories are situated at such a distance from the coal-fields that the freight on coal is very high. Inferior local coal may in some cases be used for a damage to the machinery is small, but the coal used in the kiln must contain low percentage of ash At least half of the coal used in the factories, therefore, must be from the Bengal and Bihar coal-fields.

With the exception of the works in Saurashtra and Madras, none of them are within short distances of the seaports. This gives them an advantage so far as the inland markets are concerned, as they are in a better position to compete against imported cement In the ports themselves, however, which

*Portland cement of standard specification contains

	60—70	per cent	CaO
	20—25	,,	SiO_2
	2—12	,,	Al_2O_3 & Fe_2O
And a maximum of	5	,,	MgO.

Usually three parts of limestone and one part of clay are mixed together. In ordinary practice to get one barrel of portland cement (375 lbs.) the raw materials used amount to about 610 lbs of which roughly 460 lbs. would be limestone and 150 lbs clay. Limestone with high magnesia (Mgo) is useless for cement.

being the largest towns, are great markets for cement. The Indian cement had to face severe competition in the beginning. An import duty is, therefore, levied on imported cement.

More than four-fifths of the home demand is supplied by Indian factories whose output is increasing every year. The imports are declining every year From 125,988 tons in 1928-29 they came down gradually to 55,936 tons in 1935-36. The Indian production in 1935-36 was about 9 lakh tons. In 1942 there were, however, 20 cement factories in India with a total capacity of 28 lakh tons. In 1936 Indian production (9 8 lakh tons) was about one-eighth of the total world production The imports fell from 147,704 tons in 1948-49 to 12,600 tons in 1952-53.

The Indian production rose from 35 lakh tons in 1953 to 49 lakh tons in 1956, 68 lakh tons in 1959, 78 lakh tons in 1960, 82 80 lakh tons in 1961-62 and 88.60 lakh tons in 1962-63 (provisional).

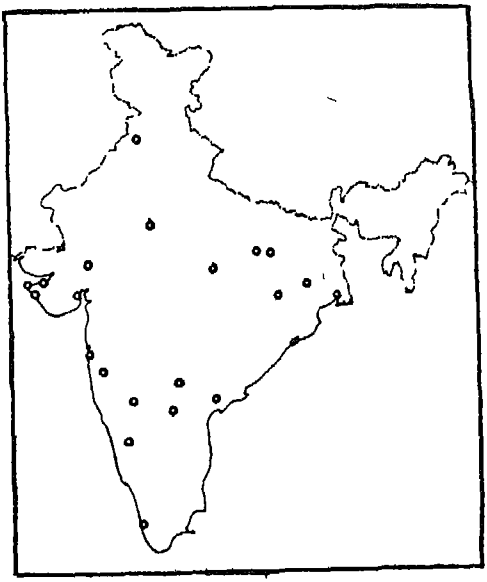


Fig 50. Location of Cement Industry

There are now 28 cement factories in India The cement industry of India employed about 30,000 persons in 1955 Nearly 40 crores are invested in the industry The consumption of fuel, electricity, lubricants amount to about 5 crores and that of raw materials Rs 10 crores. On account of the construction of the various irrigation projects in the country

there has been a great demand for cement. To increase the production further a new cemont factory had been constructed in U P at Churk about 50 miles from Chunar to which it is connected by rail. Its capacity is about 700 tons per day Out of the raw materials needed in the manufacture of cement two, namely, limestone and laterite, are obtained locally, while gypsum and coal will be imported from Bikaner and Jharia respectively Over 1.30 crore tons of limestone sufficient for 40 years is found at the Markundi quarry, 2 8 miles from the factory Laterite is obtainable from Lussa, 27 miles away

At the beginning of 1962-63 there were 34 factories of which 2 are owned by the U P. and Mysore Governments Of the factories, all privately owned, 7 are in Bihar; 4 in Gujarat and Maharashtra, 3 in Madras, 2 each in Mysore, Andhra, Madhya Pradesh, Rajasthan and the Punjab and one each in Kerala and Orissa

The important centres of this industry are.

1. Bihar—Dalmianagar, Jalpa, Chaibasa, Sindri, Khalari, Kalyanpur and Sone Valley
2. Madhya Pradesh—Jabalpur, Gwalior
3. Madras—Madhuharai, Mangalagiri, Tirunelveli and Dalmiapuram
4. Andhra—Hyderabad, Bezwada
5. Rajasthan—Sawai Madhopur, Lakheri.
6. Gujarat and Maharashtra—Okhamandal, Sevalia
7. Kerala—Kottayam.
8. Mysore—Bangalore
9. Punjab—Bhupendra, Dalmia—Dadri.
10. Orissa—Rajgangpur

At present there are about 11 different companies manufacturing cement of which Associated Cement Co Ltd, is the single largest manufacturing group The Dalmia group comes next.

The steady growth of the industry is shown below in lakh tons —

Year	Production	Capacity
1948-49	17	33
1949-50	22	29
1950-51	27	33
1951-52	32	37
1952-53	35	38
1953-54	40	42
1954-55	44	44

Year	Production	Capacity
1955-56	46	50
1956-57	56	66
1960-61	78	90
1962-63	94 7 (metric tons)	88 6 (metric tons)

The *per capita* consumption of cement in India is the lowest in the world As against the *per capita* consumption of 516 lbs in the U S A , 411 lbs in the U K , 460 lbs in Denmark, 90 lbs in Japan, 740 lbs in Sweden and 716 lbs in Belgium, the *per capita* consumption of cement in India is as low as 27 lbs. But with the large number of development schemes, it has gone up so much so that now the demand has exceeded the supply, which was further enhanced by the material emergency

Under the Third Plan the targets of installed capacity and production of cement have been set at 152 4 lakh m tons and 132 1 lakh m tons respectively This may be compared with the respective figures for 1960-61 given in the preceding chart

Over 1 lakh tonnes of cement was exported during 1961-62. An export target of 1.50 lakh tonnes has been set up for one year beginning July 1962

Schemes to establish 31 new factories have been approved by the Government; in addition to schemes for the expansion of several existing factories The new units will have a total capacity of 5 6 million tons. Of them 7 will be established in Andhra Pradesh, 7 in Bombay, 3 each in Rajasthan and Madhya Pradesh, 2 each in Assam, West Bengal and Madras, one each in U P , Bihar, Orissa, Pondicherry and Mysore. The expansion scheme will increase the capacity by about 4 4 million tons The expansion of the industry will call for an additional investment of Rs 50 to 60 crores and give employment to 50,000 to 55,000 workers more

ALUMINIUM INDUSTRY

In India the aluminium industry is a war-born industry It has made spectacular developments during the past few years, and India has now a prominent place among the world producers of aluminium It is the only non-ferrous metal of which, so far as is known, India possesses large deposits Known deposits of bauxite ore (aluminium ore) are estimated at 250 million tons of which about 40 million tons are the best quality This amount should be enough for a very long time, at least 150 years Rapid developments are taking place in the manufacture and utilisation of this metal

In America aluminium with various alloys has been used for almost every purpose including making of bridges and houses, ship-building, aircraft, etc.

The year 1938 saw aluminium produced for the first time in India at the Alupuram (Travancore State) Reduction Works of the Indian Aluminium Company. Since then spectacular developments have taken place The whole of the war-time requirements were supplied by this company Its rolling mills in Belur, near Calcutta, and the manufacturing plants produced sheet metal and components for aircraft parts, radio and field telephone equipment, range finders, field hospital equipment, etc. From technical point of view, production operations, in the Travancore factory compare favourably with the large production units in Canada and the United States of America. Carbon electrodes required for aluminium reduction are produced in the company's factory Arrangements are complete for the production of strong alloys of the duralumin type.

In India at present there are two companies which produce primary aluminium One company owned and operated by an Indian firm—the Aluminium Corporation of India (1937)—is located at Jaykaynagar near Asansol and is integrated plant which takes in bauxite and ends up with rolled metal and other finished products The other company works in collaboration with Canadian Company and has plants at different places—mining and alumina plant at Muri (in Bihar); Reduction and Extrusion Works at Alwaye in Kerala· and the Rolling mills at Belur (in West Bengal) and Powder and Paste Plant at Kalwa (near Thana in Bombay)

In addition, India also produces foil for tea-chest lining, cigarette wrapping and milk bottle strips, aluminium conductors for the electrical industry; and aluminium paste and powder for the paint trade

The following table shows the existing position of the two primary producers :—

Units			Annual Capacity	Labour Employed
1	Indian Aluminium Co., Ltd	Alumina	10 000 tons	1,467
		Ingot	2,500 ,,	
		Sheets & Circles	3 000 ,,	
2	Aluminium Corporation of India Ltd	Alumina	6,000 ,,	1,575
		Ingot	1,500 ,,	
		Sheets & Circles	500 ,,	

The annual capacity of the two plants on three shift basis at present stands at for alumina 22,400 tons and aluminium ingots 7,700 tons Actual production in 1957 for these two

amounted to 18,066 tons and 7,728 tons respectively Both these concerns have plans to expand their ingot capacity, one of them to 7,200 tons a year and the other by 20,000 tons in two stages

The important raw materials required to make a ton of aluminium are approximately as follows :—

Bauxite	4.5 tons
Petroleum Coke	0 75 ,,
Pitch	0 2 ,,
Coal	4 0 ,,
Furnace oil	0 5 ,,
Caustic Soda	0 16 to 0 2 tons
Cryolite	0 07 to 0 10 ,,
Aluminium fluoride	0 035 to 0 04 tons
Fluorspar	0 007 to 0 008 tons
Electric energy	20,000 to 24,000 k w h.

Regarding the availability of raw materials, it can be said that we have about 250 million tons of all grades of bauxite reserves Of this high grade reserves amount to about 35 million tons, which can be regarded as sufficient for the industry with a capacity of 50,000 tons per annum for at least 150 years. Bauxite is available in abundance in Ranchi and Palamau districts of Bihar, Amarkantak and Bilaspur districts of M P. Belgaum district of Bombay and Shevaroy Hills of Madras But we are deficient in coal and electric power. Other raw materials are available only partly or not at all from indigenous sources. Caustic soda, soda ash are not produced in sufficient quantities. Flourspar occurs to some extent in M P, cryolite, aluminium fluoride, carbon blocks are imported from abroad

The following table gives the actual production of aluminium in the country :—

Year	Production	Year	Production
1948	3,362 tons	1955	7,225 tons
1949	3,490 ,,	1957	7,771 ,,
1950	3,696 ,,	1958	8,182 ,,
1951	3,848 ,,	1959	17,248 metric tons
1952	3,566 ,,	1960	18,413 ,,
1953	3,758 ,,	1961	20,380 ,,
1954	4,886 ,,	1962	35,402 ,,

Under the Third Plan the expansion of Aluminium industry will be of the following ordei The annual capacity of the industry is expected to go up from 18,200 tons to 87,500 tons and the production is proposed to be raised from 18,500 tons (the target of Second Plan) to 80,000 tons by the end of the Third Plan.

PAINT INDUSTRY

The paint industry is another important chemical industry in India This industry had its beginnings here as far back as 1902, when the first commercial factory was established at Goabaria, near Calcutta, and for several years after, this pioneer factory continued to be the only producer and did much valuable research work in establishing the fact that the Indian products could compete favourably with imported articles of paint. With the outbreak of the Great War of 1914, not only were imports restricted but there was a considerable increase in the demand for paint products As a result of this situation there are today about a dozen factories manufacturing paints and varnishes, etc

The paint industry in India has been assisted to no small extent by the fact that we produced in our country many of the essential raw materials in paint manufacture, *e.g* linseed oil, turpentine, red and white lead, red oxides, ochres and barium sulphate

The real development of the industry, however, dates back to a very recent date. It is only since 1937-38 that the imports of paints and their products have decidedly declined. Simultaneous with this, the Indian products have shown a steady rise But even now the imports of paints and painters' materials account for considerable import into the country.

The following table shows the production of paints and varnishes for recent years :—

1950	27,948 tons	1956	41,424 tons
1951	33 492 ,,	1957	42,276 ,,
1952	32,172 ,,	1958	47,832 ,,
4953	32,052 ,,	1959	55,000metric tons
1954	36,816 ,,	1960	51,000 ,,
1955	39,036 ,,		

We import large quantities of paints and varnishes especially dyes (from coal tar) in enormous quantities.

THE CHEMICAL INDUSTRY

The progress of Indian chemical industry must play a very important part in the broadening of India's economy. The

manufacture of heavy chemicals is not advanced in India, even though some of the raw materials of this industry are found here The manufacture of acids, alkalis and their salts forms the background of heavy chemical industry India is poor in sulphur which is the basic component of the heavy chemical industry. At present all sulphur needed by us is being imported either from Sicily, Japan or from U S A To replace totally or even partially this imported sulphur, India can only fall back upon the scanty deposits of pyrites near Simla Still more inaccessible deposits in Assam and comparatively good deposits of gypsum in Madhya Pradesh are also available The other source, not of any considerable magnitude, is in the recovery of sulphur oxide produced in the roasting of copper ores near Ghatsila which produces about 7,000 tons per year. Another source that is tackled even in highly industrialised countries abroad is coal. But our coals are poor in sulphur, except the deposit of a tertiary nature in Assam, where the organic sulphur content is very high.

The impetus given by the War has resulted in considerable progress in heavy chemical industry in India The production of soda ash, chlorine and bleaching powder has now begun here A factory for bleaching powder at Rishra, and for soda ash at Port Okha have been started. Sulphuric acid is manufactured at various places, specially at the Tata Works in Jamshedpur, Digboi Oil Company Works in Assam, and at the Mysore Chemical and Fertilizer Works

India is backward in the production of heavy chemicals One of the reasons for this backwardness is the lack of suitable raw materials in required quantities India does not possess industrial salts, sulphur, or copper in any considerable amount. Without heavy chemicals, however, not only is the general industrialization of the country impossible, but the artificial manures necessary for increasing the yields of agricultural crops cannot be obtained The ammunition for our armies is also supplied by heavy chemicals. The starting of the heavy chemical industry was, therefore, considered essential for the progress of the country

In 1943, the Foodgrains Policy Committee of the Government of India advised that, in future, India would require two to three million tons of nitrogenous fertilizers, costing about 70 crores of rupees per annum It recommended immediate action to establish a factory for nitrogenous fertilizer Realising the importance of this industry as a defence potential, the War Resources Committee resolved at the end of 1943 that the Government should undertake the responsibility for such a factory as a nationalized industry. During the next few months steps

were taken to start the artificial fertilizer industry at Sindri near Dhanbad in Bihar as it had the advantage of water supply facility of getting the raw material, and its situation near the coal mines The two most important reduirements of the fertilizer industry are the supplies of gypsum as the raw material, and plenty of water Gypsum was expected from the Salt Range of West Pakistan As a large amount of coal was being sent to the Punjab, considerable number of wagons were returning empty to the coal mines The cost of transport of gypsum supplies to Sindri was, therefore, expected to be low Due to the partition, however, the Salt Range gypsum could not be depended upon Luckily, large amounts of gypsum occur near Bikaner and Jodhpur These are being developed and about 1 lakh tons have already been stockpiled at Sindri The main difficulty is the transhipment at Agra where the broad gauge changes to the meter gauge When in full operation, the Sindri Fertilizer Factory would require about 2,000 tons of gypsum every day

The water requirements of the factory are estimated to be large, about 12 million gallons per day. These are supplied from —

(i) An artificial lake built by a dam on the Gowai river which is a tributary of the Damodar joining it about four miles upstream from Sindri;

(ii) An Infiltration Gallery to tap the water available in the sands in the bed of the Damodar when the surface flow diminishes; and

(iii) The Pumping and Purification Works on the Damodar river

The factory itself can be divided into four main groups, namely, (i) Power House, (ii) Gas Plant, (iii) Ammonia Synthesis Plant and (iv) Sulphate Storage Plant The power-house contains the complete plant for generating power for the factory and the supply of process steam The power-house supplies not only power and steam for process work necessary for the operation of the factory, but also exports power to the D V C grid, for the much-needed expansion of coal mining, and for industry development generally in the Damodar Valley area, including the big Chittaranjan Locomotive Workshop at Mihijam near Asansol

The Sindri Fertilizers went into operation in 1951 In 1960-61 it produced 3,05,218 metric tons of ammonium sulphate The scheme to raise the output by about 60% has been completed at a cost of about Rs 15 crores and is expected

to produce 70 tons of urea and 400 tons of ammonium sulphate nitrate per day In 1960-61 the factory produced 10.6 thousand metric tons of urea and 36 thousand metric tons of double salt *i.e.* ammonium sulphate nitrate.

To meet the anticipated demand for nitrogenous fertilizers a factory is being set up at Nangal for the production of nitro-limestone and heavy water. The fertilizer part of the factory was completed in February 1961 and has produced 1 52 lakh tons of calcium ammonium nitrate in 1961 Additional units are to be set up at Neyveli, Rourkela, Trombay and Naharkatiya (Assam) with annual production capacities of 70,000, 80,000, 90,000 and 32,500 tons of nitrogen respectively

There is a number of smaller works where different kinds of heavy chemicals are manufactured, specially with imported raw material Trivandrum, Calcutta, Kanpur, and Asansol are among the most important places for this production

Heavy chemical refers to those chemicals which are produced in large quantities, usually at low cost and which serves as raw materials for other industries Heavy chemicals thus include mainly sulphur and its compounds, acid, soda ash, caustic soda and phosphates and ammonium sulphates These are largely used in textiles, leather and paper industries These heavy chemicals are at present, manufactured at Calcutta, Bombay, Kanpur, Madras, Bangalore, Delhi and Amritsar.

Coal-tar Chemicals form the foundation of the organic chemical industry from which benzole, anthracene, and anthracene oil are obtained for use in dyes, explosives, perfumes, flavouring essences, plastics, pharmaceuticals and photographic Chemicals The manufacture of Coal-tars is concentrated in Kulti, Bombay, Calcutta, Jamshedpur, Hirapur and Sindri.

The production of heavy chemicals in 1950, 1955 and 1960 in India was as follows .—

Chemicals	1950 (000 Tons)	1955 (000 Tons)	(Metric tons) (60-61)	
Sulphuric acid	102	166	360	(m tons)
Soda ash	44	77	145	,,
Caustic soda	11	34	95	,,
Superphosphates	54	74	..	,,
Ammonium sulphate	47	393	388	,,
Liquid Chlorine	4	12	.	,,
Bleaching Powder	3	3	5.9	,,
Bichromites	2	3		,,

The great demand for "khaki" cloth for soldiers during the War led to a considerable production of bichromates of soda and potash Madras, Mysore, Bombay, Kanpur and Calcutta have factories for these.

During the First and Second Plans (1951-52 to 1960-61) there has been remarkable progress in chemical industries The output of basic chemicals such as nitrogenous fertilizers, caustic soda, soda ash, and sulphuric acid etc has greatly increased The manufacture of a number of new products has been started such as urea, ammonium phosphate, penicillin, synthetic fibres, industrial explosives, newsprint and dyestuffs etc The Government of India have set up a D D.T. factory in Delhi with the assistance of UNICEF and WHO A second D D T factory has been set up at Alwaye in Kerala A penicillin factory has been started at Pimpri near Poona, where a streptomycin plant is also being set up.

The following table shows the achievements of principal chemical industries and their targets during the plans·—

	Industry	Unit	End of first plan (55-56)	End of Second Plan (1960-61) Capacity	Production	Third Plan targets (1965-66) Capacity	Production
1.	Nitrogenous Fertilizers	'000 tons	79	248	110	1,000	800
2	Sulphuric Acid	'000 tons	·164	476	363	1,750	1,500
3	Soda Ash	,,	81	268	145	530	450
4	Caustic Soda	,,	35	124	100	400	340
5.	Dyestuffs	Million lbs	¼	18	11 5	22 4	18

TOBACCO INDUSTRY

Tobacco in its different varieties and forms has proved to be a veritable gold mine for our Nation's Exchequer During 1957 it contributed Rs 35 6 crores to our Exchequer, besides giving producers every year on an average 32 4 crores of rupees, and earning valuable foreign currency worth about Rs. 15 crores

The value of Indian tobacco production comes to 36 crores of rupees. This includes both manufactured tobacco—cigarettes, cigar, cheroots, bidis and snuffs—as well as some other semi-manufactured forms of Hookah tobaccos.

The industry got its impetus during a period of 15 years—from 1920-35 There has been a general increase of the number of tobacco factories since 1923 During the year 1935, 22 registered cigarette factories employed 8,000 persons daily.

Over half of the cigarette leaf produced in India is purchased by the Indian Leaf Tobacco Development Company for export and sale to the manufacturers in the country About ¾ of the output of cigarettes in India is handled by four Indian factories. These factories are located at Bangalore, Saharanpur, Monghyr and Calcutta

Between 22-23 million lbs. of tobacco leaf is used for the manufacture of cigarettes About 15% of this is imported from the United States Annual production of cigarettes is 22,828 million its value being nearly 10 crores of rupees Leaves undergo a complex process of grading, blending, flavouring and moistening before being ready for manufacturing Fast running machines and skilled workers are required in order to make satisfactory cigarettes The cigarette paper[1] is properly printed by the same machine Care is taken for sealing and scientific packings by using transparent papers to make them moisture proof Most of the cigarette factories are located in Calcutta, Bombay, Baroda, Allahabad, Monghyr, Jullundur and Hyderabad.

Cigar. Madras specialises in cigar manufacture, which is different from cheroot in shape The quality of leaf used for cigars, as well as the value of ready product, is much less than of the cigarettes Cigar manufacture is simpler than the cigarette manufacture and may be done by an elaborate machine. The quality of the cigar depends on the leaf which is wrapped on it. The filler leaves used are of Trichinopoly origin and occasionally also from Guntur. The process of cigar manufacture consists of rolling, pasting the tip ends and heating at 150° to 160° of temperature to ensure its safety from insects.

Cheroots Madras is the main cheroot manufacturer The average annual output of cheroots in India is estimated at 60-92 million lbs or 18,500 million cheroots valued at over 9 crores of rupees Thus it is more important than the cigarette manufacture.

Cheroot making is practised as a cottage industry Rolling of cheroot and management of business is always done by woman labour. The quality depends on the coloured leaf wrappers,

[1]Cigarette paper is being produced by the Eastern Tissues Ltd Raniganj and Tribeni Tissues Ltd

filler lead and flavour. The Madras cheroots are large, thin and dark-coloured.

Bidi is a cheap smoke. Bidi cheroots are large thin and Northern as well as Southern India Its importance is both as an indigenous as well as commercialized industry. Over 55,000 million bidis are annually manufactured in India using about 70 million lbs. of tobacco. The total manufacture is estimated at 7 5 crores of rupees.

The manufacture of Bidis is more popular in the Deccan than in Northern India. Almost all the large towns in India are large centres of bidi industry. Poona is considered as pioneer of bidi manufacture in South India Bhandara district in M P. has special advantages for bidi industry Cheap and plentiful supply of wrapper leaf and labour gives vitality to the industry there. Jabalpur, Gondia, Nagpur and Kamptee are the leading and controlling centres of industry. It is a flourishing industry in Madhya Pradesh and gives employment to over 42,000 persons Bhandara district alone employs about 31,000 people.

Cheap tobacco with mixtures is used for bidi filling, thus making it cheap The Deccan forests abound in the wrapper leaves, which are obtained at a very low price The process of bidi making is simple The wrapper leaves are first moistened to facilitate folding Moistening of leaves is done at night to begin with the work during day time Drying of the packets is the final process under artificial heat Packing is done on contract for the sake of economy in production

Hookah Tobacco. It is an important smoke for Northern India All towns and villages manufacture **Hookah** tobacco Delhi, Lucknow, Rampur and Gorakhpur are the chief centres Annual output comes to about 6 million lbs.

There are two types of **hookah** tobacco, one is '**karuwa**' and the other '**mitha**'. Cured tobacco plant is dried and powdered This powder is mixed with the jelly obtained from semi-used molasses. The kinds of '**karuwa**' or '**mitha**' are made according to the proportion of mixture and various ingredients to give smelling and taste Preparation of 'khameera' takes a longer time to be useful. Manufacturers use adulterants for making it cheap

Chewing Tobacco. Zarda, Qiwami or **Danedar** are the chief chewing tobaccos in the market Delhi, Lucknow and Varanasi are the most important places of manufacture The leaves are boiled in lime water and then dried and scented. Chewing tobacco is also used raw by the villagers. Over 156 million lbs. of

chewing tobacco leaf valued at a little over 3 crores of rupees is annually consumed in the country

The Snuffs. The manufacture of snuffs also extends all over India The annual average production in India is estimated at 21 million lbs. valued at about a crore and a half of rupees.

In 1958, India produced 299,356 lakh cigarettes.

INDUSTRIALIZATION OF INDIA

Large-scale industrial development in India, specially that of the 'key industries' cannot progress far without considerable Government help The main item in such a help is one of Protective Duties levied on imports of manufactured articles. These duties tend to raise the prices of manufactured articles to the consumer There has, therefore, been a good deal of controversy within recent years for and against industrialization in India.

The main arguments against industrialization are —

1. Industrialization of India will cut off imports because they consist of manufactured articles This will automatically result in the reduction of our export trade, as the imports and exports tend to balance each other Foreign countries will not buy our goods because we do not buy theirs

2 Industrialization lays a burden on the Indian consumer who is usually the poor Indian cultivator and who also loses the foreign market for his produce This burden consists in the higher prices and the heavier taxation, which naturally result from the protective policy

The main arguments for industrialization are.

1 Industrialization increases employment in the country all round Labourers get more work, railways and transport agencies handle more goods, and the Government gets more revenue from taxation For the effect of industrialization is to increase incomes generally.

2 Industrialization provides an alternative source of employment to the people, and an alternative source of revenue to the Government, whenever the main occupation of the country, *i.e.* agriculture suffers.

3. It is not correct to presume that if protection had not been granted to a particular industry, the consumer would have obtained the goods in question from foreign countries at a lower price On the contrary, it is obvious that the establishment of indigenous industries tends to bring down prices, as has been the case in cotton textiles in the past.

4. India's exportable commodities are of a monopoly on semi-monopoly character and hence the foreign countries must come to us for buying them There is, therefore, no danger of our cultivator losing the market for his produce.

5 Industrialization is not likely to stop India's import trade, although it might change its character and composition The very process of industrialization is bound to release the large potential purchasing power of the people and also increase production, both industrial and agricultural, thus encouraging both the import and the export trade.

INDUSTRIAL REGIONS OF INDIA

India is industrially a backward country, yet there are certain areas which show, owing to the concentration of certain manufacturing industries, all the characteristics of industrial regions These characteristics may be said to be

(i) Large urban population;

(ii) Large banking facilities,

(iii) Integration of some main industry around which group a number of subsidiary industries;

(iv) A network of communication lines, and

(v) A large market for labour.

Bearing these facts in mind, it cannot be said that every town or centre where some sort of manufacturing is done should be described as an 'industrial region' This term should be reserved only for those areas which possess all the characteristics listed above. The underlying idea is that in an 'industrial region' a particular industry and the occupations depending directly upon it from the major source of the income of the people there This criterion naturally leaves out from our discussion a large number of isolated places in India where manufacturing industries, depending upon some local geographical advantages are carried on. Such, for example are the places where a solitary cotton-ginning factory or solitary cotton mill may be working or where there may be a small glass factory or a cement or lime factory

The following are, therefore, the main industrial regions in India —

1 Calcutta

2 Bombay

3. Coimbatore

4 Madras.
5 Tatanagar.
6. Ahmedabad
7. Kanpur

Calcutta is most important industrial region in India. A great variety of industries is carried on in Calcutta, but the main industries are jute, paper, iron and cotton. These industries are located mainly outside the congested town of Calcutta Howrah, Lillooah, Belur, Dum Dum and Budge Budge are some of the important suburbs of Calcutta where these industries are carried on The industrial sites have been selected mostly along the banks of the river Hooghly which serves as an important line of communication with the town and port of Calcutta, besides the railways that serve Calcutta An important feature which distinguishes the Calcutta industrial region from the Bombay industrial region is the quarters provided for the labourers near the factory itself The long distance that ordinarily separates the factory from the Calcutta town makes this necessary, while the large areas of open land near the factories make the building of labour quarters possible. In Bombay, on the other hand, the mills are generally situated within the town in congested areas The Chawls (the houses where the mill workers live in Bompay) are, therefore, part of the town

The geographical factors have led to the rise of industries near Calcutta may be summed up as follows:

(a) *Situation at the head of the estuary and the Valley of Ganga.* On the one hand, this enables an easy contact with the sea facilitating the imports of machinery and the export of finished good; and on the other hand it gives an access to the interior of the country through various railways and roads connecting Calcutta with the coalfields, the sources of raw material, the sources of labour supply, and the chief markets which require the articles manufactured at Calcutta.

(b) *Nearness to Coal.* Most of the coal produced in India is within easy reach of Calcutta There is no other manufacturing region in India which is situated so near the coalfields as Calcutta Coal is used in Calcutta industries for generating steam with which the machines are driven, and also for generating electricity which is used in the factories for numerous purposes

(c) *Nearness to Raw Material.* Raw jute, the basis basis of the most important jute mill industry of Calcutta is

found near at hand The raw materials for other industries like the paper, leather, iron, chemical and textile industries can also be obtained from nearby places easily.

(d) *Labour Supply.* The dense population of the Ganga Valley is a vast source of cheap labour for Calcutta. Several places near Calcutta, like Murshidabad and Dacca, have been famous in the past for the skill of their textile workers It is true that the modern factory today has no use for that type of skilled labour. But it cannot be denied that the old textile industries of Murshidabad and Dacca had brought into existence a group of workers who, because of their life-long work in textile industries, were able to pick up the new technique of manufacture quickly.

(e) *Market.* The vast population of the Ganga offers an immense market for things produced in this industrial region

(f) *Economic Advantages.* The early start of bankking facilities, the development of railways, the settlement of Europeans at an early date in Calcutta, were some of the economic advantages that helped the rise of industries in this region.

Except jute, which depends on foreign markets for its prosperity, all other industries carried on in Calcutta cater for the home market

Bombay is an important industrial centre of India, its importance lies chiefly in the fact that the only truly 'Indian' industry, the cotton mill industry, in which the capital and the organisation are both Indian, is centered at Bombay.

Bombay is, however, a small island with hilly area at its back. This limits the area of level land where factories can be erected It is also far away removed from the coal-producing regions of India Its advantage is in the fact that it is a port having a vast foreign and coasting trade It can, therefore, import cheaply by sea whatever it needs It has also good rail connections with the interior

A unique feature of Bombay is that in the neighbourhood of Bombay lies the most important hydroelectricity-generating region in India Bombay now, therefore, depends largely on this hydro-electricity for its industrial development.

The most important industries carried on in Bombay are the textile engineering and chemical industries.

In Bombay state outside the town of Bombay, the various industrial centres like Ahmedabad, and Sholapur are important for the manufacture of cotton goods, owing to the proximity of raw cotton

Among the difficulties which have tended in the past to restrict the development on a large scale of industries in Madras are the high price and scarcity of fuel, owing to the fact that nowhere south of Hyderabad has coal been found to exist in workable deposits. The hydro-electric and thermo-electric projects which have been completed or are under construction or contemplation will, however, go far to remedy the deficiency and admit of the exploitation of the natural resources of the state to the maximum possible extent. The extent of development of electricity will be realised when it is mentioned that during the last decade the number of units generated has increased from 20 million to 170 million units Already, the possibility of establishing several important industries not thought of years ago, has been opened up by the advent of cheap electric power over a wide area of Madras, while the existing industries have been benefiting thereby in an increasing measure.

The industrial importance of some of the various States in India is given below·

State	Average daily number of workers employed		
	1939	1955	1957
Andhra	N. A.	117,514	297,445
Assam	43,936	68,647	119,710
Bihar	95,988	172,062	351,057
Maharashtra and Gujarat .	466,040	863,029	19,53,372
Madhya Pradesh.. ..	69,494	130,576	171,326
Madras .. .	197,266	327 926	612,083
Orissa .. .	5,371	20,328	55,743
Punjab .. .	22.468	63,712	167,167
U. P. .. .	159,738	245,613	539,587
West Bengal ..	532,830	616,739	12,84,099

QUESTIONS

1. Compare and contrast the cotton industries of India and Japan.

2 Discuss from the geographical point of view the recent development of the sugar industry in India

3 Why is the Indian cotton not so popular in Lancashire as in Japan? Discuss the factors that retard the popularization in India of cotton that can find a market in Lancashire

4 Assign geographical causes for the existence of a very large Number of Sugar factories in U P

5 What major industries can be best developed in India? Discuss.

6 Under what geographical conditions is the steel industry carried on in Tatanagar?

7 Discuss the causes of the present backwardness of industrialization in India

8 Discuss the geographical factors underlying the development of iron and steel industry in India.

9 What is the importance of Cotton Textile Industry in Indian Economy? What geographical factors led to this importance?

10. Discuss the importance of the following Indian industries giving geographical causes

Paper, Matches, Cement and Glass

11 What is the geographical background of the Cottage Industry in India? Why are most of the cottage industries in India on the decline?

12 Give the arguments for and against industrialization of India.

Chapter 10

Communications

India is a vast country with a huge population, and yet the lines of communications are not as well developed here as they are in some of the countries of the West. The backward state of commercial development is its main cause. Until recently Indian economy has been characterised, more or less, by self-sufficiency in which transport played very little part The development of communications in India is a feature of the modern times when her contact with the West brought about the development of a foreign commerce in which, unlike the commerce of the ancient times which was marked by light and precious goods, heavy goods predominate Unlike the old foreign commerce which followed the land route, this foreign commerce in heavy goods passed through sea-ports which had, therefore, to be connected with the inland centres by modern means of communications

The most important of the sea-ports on which the foreign commerce of the country concentrated, later became important industrial centres which necessitated a further development of communications between these ports and the inland towns, for their market as well as the source of raw material lay in the hinterland. The main feature of the communications in India is that they especially join the sea-ports to their hinterland, there being a marked absence of large industrial and commercial centres inland

From many points of view, the railway is the most important means of transport in India There are about 35395 route miles (57089 Kms) of railways open for traffic in India. This gives less than 30 route miles for every thousand square miles of area This is insignificant when compared with some of the countries of Western Europe which are essentially industrial, but when compared with the essentially agricultural countries, the position is not so hopeless

Of the total route mileage roughly about one-half is in the Indo-Gangetic Valley which, with its fertile plains and large population together with Calcutta, one of the biggest Indian

sea-ports, naturally offers the most favourable conditions for railway development. Before partition at one time this Valley possessed the longest Indian railways (the N W R, 6,900 miles), the busiest Indian Railway (the E. I R. earning about 17 crores of rupees annually), and the most profitable Indian Railway (the Shahdara Light Rly.) yielding obout 10%, on an average between 1926-27 and 1935-37 and B. & N. W R. yielding about 9% for the same period

The general characteristic of the route in this valley is that it is straight over long distances. The absence of hills enables the railway line to run for miles without changing its course. But while the level nature of the valley helps the railway, rainfall and the numerous streams necessitating costly birdges are a drawback. The frequent floods also raise the cost of maintaining the track The ballast for the railway track is available from the hills adjoining the Indo-Gangetic Valley.

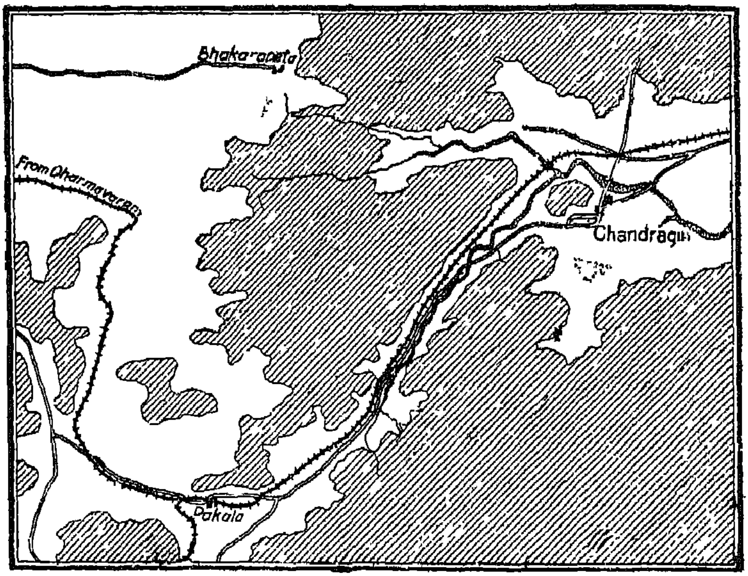


Fig 51.

The railway lines in the Gangetic Valley are characterised by a large number of branch lines The branches are particularly numerous in areas where the traffic is spread over the adjoining area The best examples of such areas are the Raniganj and Jharia coalfields. There is no other part of India

where the network of railways is so dense as in these two areas. The network of railways is denser in the Indo-Gangetic Valley than in the Peninsular India The railway lines of the Indo-Gangetic Valley terminate at Calcutta while towards the north the Himalayas are a natural barrier to further extension It is only near Darjeeling and Simla that the mountain railways have penetrated the outer ranges of the Himalayas

The railway lines running in the Peninsular India are zig-zag as compared with the almost straight lines in the Indo-Gangetic Valley The broken topography of the south compels the lines to change their course and gradient from place to place The gradients are here much steeper than in the level plains of the Indo-Gangetic Valley These steep gradients necessitate the service of a 'banking' engine at some places; as for example, near Hoshangabad and near Igatpuri on the old

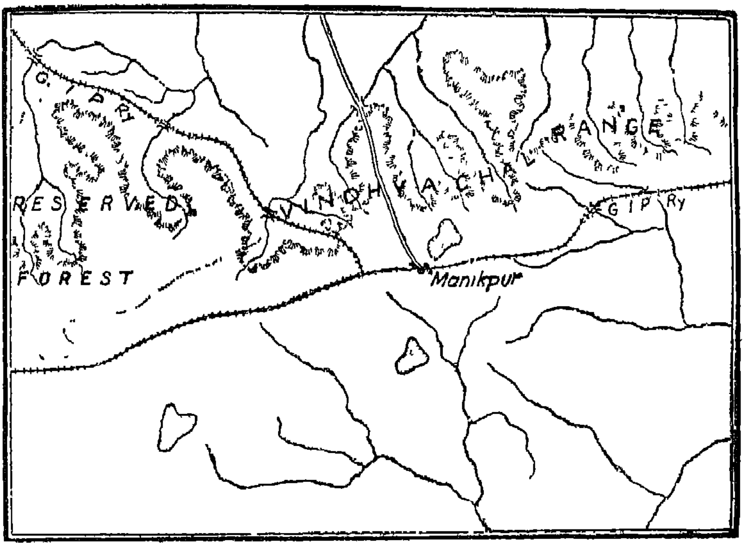


Fig 52

G I P Railway The broken and hilly nature of the Peninsula also causes the making of tunnels at some places to get over the obstructions The railway building is therefore a much more expensive business in the south than it is in the Indo-Gangetic Valley

The control of relief on the direction followed by the railway line is very marked in the south Sometimes, the railway line has to make a long detour in order to avoid some obstruc-

to take advantage of some gap. In Fig. 52 it is shown how the railway lines make detours to avoid crossing a number of streams which will need to be bridged Fig. 52 shows how a railway line turns to avail of a narrow river valley which is used also by a road

There are two large areas in India which are particularly deficient in railways. These are (a) the Thar and Rajasthan deserts and (b) the broken and hilly land of Chhota Nagpur and Orissa These areas are very thinly populated and have very little need for railways

INDIAN RAILWAY SYSTEM

The Indian railway system is the largest in Asia and fourth largest in the world It is the country's biggest nationalised undertaking with a route mileage of 35395 (57089 Kms) The railway constitute India's principal means of transport and carry about 80% of the goods traffic and 70 p c of the passengers In 1961-62 on an average about 46 lakhs persons travelled in 4500 trains to or from 6400 railway stations daily In 1961-62 the railways carried an average 4 4 lakhs tons of goods daily About 3 62 lakh tons of goods were carried by 3000 goods trains daily loading 23000 wagons per day The total capital-at-charge was about Rs 1690 crores at the end of 1961-62, and the gross earnings were Rs. 502 crores The railways employed about 11.76 lakh persons and paid Rs. 214 51 crores in wages and salaries

The following table gives some interesting facts about railway progress in the country

	1950-51	1955-56	1960-61	1961-62
Total kilometrage	54,845	55,900	56,963	57,089
Capital-at-charge (in lakh Rs)	83,818	97,591	1,52,783	1,69,007
Gross-earnings (in lakh Rs.)	26,462	31,751	45,938	50,229
Passengers carried (in '000)	13,07,790	12,97,431	16,15,894	17,12,839
Passenger's Earnings (in lakh Rs.)	9,922	10,875	13,252	15,185
Goods carried ('000 tonnes)	93,822	1,17,120	1,57,643	16,18,860
Goods Earnings (in lakh Rs)	13,977	17,792	28,126	30,080

India has got 57,089 kilometres of railways which operate on three gauges, (i) the broad gauge (5′ 1|3″); (ii) metre gauge (3′ 3⅜″), and (iii) narrow gauge (2′6″ and 2′) .

Before the railways were taken over by the Govt in 1944, there was a complicated system of ownership and control. Some were State-owned and State-managed, a few State-owned and company-managed and others, company-owned and company-managed. The existence of a large number of big and small units was neither conducive to efficiency nor economy Hence with a view to effecting economy and efficiency in administration a scheme for regrouping of the entire system was prepared by the Railway Board in 1950 and enforced in 1952 By regrouping there was 37 railway systems in India of which 9 were major, namely, (1) East India Rly (2) Bengal Nagpur Rly. (3) Oudh and Tirhut Rly (4) Assam Rly (5) South India Rly (6) Madras and South Maharatta Rly. (7) Bombay-Baroda Central India Rly (8) Great Indian Peninsular Rly and (9) East Punjab Rly. All these systems have been gradually consolidated into 8 separate zonal railways·

As a result of re-grouping, the following zonal divisions have been created:—

	Zone	*Date of Forming*	*Former Rlys included*	*Head quarters*	*Route Kilo meterage as on March 31 1962*
1	Southern	April 14, 1951	M & S M, S. I., and Mysore Rlys	Madras	9938 95
2.	Central	Nov. 5, 1951	G I P., Nizam's State, Dholpur and Scindia Rlys	Bombay	8861·26
3.	Western	Nov 5, 1951	B B & C I , Saurastra , Kutch, Rajasthan and Jaipur Railways.	Bombay	10069.86
4	Northern	April 14, 1952	East Punjab, Jodhpur, Bikaner the three upper Divs of E I Rly and a portion of B B & C I	Delhi	10364 17
5.	Eastern	Aug 1, 1955	E I Rly (minus 3 upper Divs)	Calcutta	3846 23
6	South Eastern	Aug 1, 1955	B N Rly	Calcutta	5897.90
7	North-Eastern	April 14, 1952	O T & Fatehgarh Dist of old B B & C I.	Gorakhpur	4923.12
8	North East-Frontier	Jan. 15, 1958		Pandu	2856 48

1 *Northern Railway.* Came into being in 1952 through the amalgamation of three divisions of E.I Rly, a portion of Bombay, Baroda and Central India Rly. and the whole of Jodhpur, Bikaner and East Punjab Rly This line serves Punjab, Delhi, northern and eastern Rajasthan and U. P upto Varanasi Broad and meter gauge lines operate The main broad-gauge lines are (i) Delhi—Atari, (ii) Delhi—Ferozpore, (iii) Delhi—Kalka and (iv) Delhi—Varanasi While the meter gauge connects Delhi with Bikaner, Anupgarh and Pokhran Its total kilometerage is 10364 17 kms

2 *Southern Railway* On April 14, 1951, the three railway systems—Madras and South Maharatta Rly, South Indian Rly and Mysore Rly—were integrated into a single railway zone serving the Madras, Mysore, Kerala and parts of Northern Maharashtra and Andhra This railway links the northern and southern portion of India and handles grain, cotton, oilseeds, salt, sugar, tobacco, timber, hides and skin This railway, too, has got both the gauges, meter gauge and broad gauge Its railway kilometerage is 9938.95 kms.

The main broad gauge lines are. (i) Madras—Waltair, (ii) Madras—Raichur, (iii) Madras—Bangalore and (iv) Jalalpet—Mangalore While the meter gauge lines are (i) Poona—Harihar (ii) Guntakal—Masulipatam, (iii) Madras—Dhanuskodi and (iv) Madras—Trivandrum

3. *Central Railway.* Consisting of G I P Rly, Scindia, Dholpur and Nizam State Rly, serves the States of Madhya Pradesh, Maharastra & Gujarat and north-western part of Madras This line handles manganese, cotton and timber It normally carries 50 million passengers and about 11 million tonnes of goods

Its main lines are (i) Bombay—Delhi, (ii) Bombay—Raichur, (iii) Delhi—Bezwada

4. *Western Railway* Comprising of B B and C I Rly the Saurashtra, the Jaipur and Rajasthan Railways, serves Bombay, Rajasthan and Madhya Pradesh It serves the great industrial areas of Bombay, Ahmedabad and Baroda and handles large quantities of cotton, mica and oilseeds, salt, etc This line carries about 10 million tonnes of goods and 8 million passengers annually

Its broad gauge lines are Bombay—Delhi, (ii) Bombay—Ahmedabad While meter gauge lines are (i) Ahmedabad—Delhi; (ii) Ajmer—Khandwa, (iii) Porbandar—Dhola; (iv) Rajkot—Veraval, (v) Kandla—Bhuj and (vi) Surendranagar—Okha

5. *Eastern Railways* serve an area of 80,000 sq miles and cover the States of West Bengal, Bihar and parts of U P which

have a heavy population density It is composed of five divisions of E I Rly—Dinapore, Dhanbad, Asansol, Howrah and Sealdah —all east of Moghalsarai. This railway connects the port of Calcutta with its rich vast hinterland It handles large quantities of rice, jute, coal, iron ore, mica and manganese

It serves important industries like the metallurgical and steel manufacture at Burnpur and Kulti; chemical fertilizers at Sindri, Locomotives at Chitranjan The Transport demands of the various industries like jute, chemicals, paper, engineering, cement, leather and tiles, situated around Calcutta, and at other centres is also met by this railway

The important lines are (1) Howrah-Moghalsarai *via* Gaya, (ii) Howrah-Moghal Sarai *via* Patna and (iii) Howrah-Kiul

6. *North Eastern Railway* has been formed with the former Oudh and Tirhut Railway and Assam Railway It serves the northern part of West Bengal, Assam, northern part of U P. and Northern Bihar. It carries large quantities of sugarcane, tobacco, tea and rice

Its main lines are. (i) Gorakhpur—Amingaon; (ii) Gorakhpur—Lucknow—Kanpur, (iii) Gorakhpur—Allahabad and (iv) Pandu—Gauhati—Tinsukia Its kilometerage is 4923 12

7. *South Eastern Railway* connects the capital cities of three States, *viz*, West Bengal, Orissa and Madhya Pradesh and serves an area of 185,600 sq miles in these states as also in Andhra and Bihar, connecting the ports of Calcutta and Vishakhapatnam with their vast hinterlands, it serves the rich paddy fields of Bengal, the extensive timberlands of Orissa and M P as also the coal and steel industries of Bihar and in Bengal The area covered by the railway is very rich in iron ore, copper, coal, manganese, lime, bauxite and dolomite. Many of the major development projects in eastern India lie on this railway, such as Hirakud Project at Sambalpur, two new steel plants at Rourkela and Bhilai, Hindustan shipyards at Vishakhapatnam, Oil refinery at Vishakhapatnam and two steel works at Tatanagar and Burnpur

8 *North Eastern Frontier Railway* This railway came into existence on 15th Jan 1958 It serves the northern parts of west Bengal and Assam The main line runs from Pandu to Tinsukhia—a distance of 520 kms It was created out of North-Eastern Railway and has its headquarters at Pandu

ELECTRIFICATION OF INDIAN RAILWAYS

The total electrified route mileage on the Indian railways on March 31, 1960 was 330 9 miles composed of (i) Central Railway (Bombay—Kurla—Kalyan, Poona—Igatpuri and Kurla—Mantchurd)—184 85 (ii) Southern Railway (Madras—Tambaram) 18 14 (iii) Western Railway (Bombay—Borivali—Virar) 37 25 miles (iv), Eastern Railway 88 63 miles

In the following table the position of India is compared with some other countries·

Country	Electrified Route Mileage	Track
U. K	905	2,303
Japan	3,591	6,008
Germany	1,843	4,300
America	2,708	4,525
France	2,520	4,674
Italy	3,205	6,458
Sweden	3,915	5,893
Switzerland	3,008	2,565
Russia	1,040	1,565
India	240	523

The Second Plan provides for the electrification of 1,442 miles of railway lines on the following section

Eastern Rly—730 miles, South-Eastern Rly—420 miles; Central Rly.—192 miles, and Southern Rly—100 miles

Sixty eight miles were electrified on the Eastern Railway between April 1960 and February 1961

In order to meet the increased demand for rail transport, the Second Plan provides for the doubling of 1,607 miles of railway lines distributed thus Eastern Ry 43 miles, South-Eastern Rly 605 miles; Central Rly 214 miles; Southern railway 402 miles, Northern Rly 151 miles; Western Rly. 163 miles and North Eastern Rly. 29 miles

It also provides for the conversion of 265 miles from meter gauge to broad gauge on the Southern Railway Diesel traction has been adopted on a few selected routes A route mileage of 1,293 would also be dieselised

ROADS

The road is the indigenous means of communication in India. Over a large part of India road building of the unmetalled type is a simple affair and presents no great difficulty Even the metalled roads were not unknown in India as the excavations at Mohenjodaro in Sind clearly show The road is a much cheaper means of communication than the railway, but it is not so effective and serviceable, especially the unmetalled one, as the railway. During the rainy season the unmetalled roads become impassable in most cases, and even the metalled ones are seriously handicapped when floods invade them On such occasions the railway alone, with its high embankment and efficient maintenance service, solves effectively the problem of communication. But the railway mileage is small and cannot possibly serve cheaply all the needs of a vast and poor country like India. Roads, therefore, naturally play a very important part in the country's communication

But unfortunately the road system in India is not well developed India's deficiency in the matter of roads has contributed very largely to the agricultural, commercial and industrial backwardness today. The most serious defect is the lack of proper and adequate road system between villages and the markets Another aspect of inadequacy of our road system is that it is unbalanced, *e.g.*, the trunk roads are relatively more highly developed than the district and village roads Most of the rural roads are fair weather roads With the arrival of the Monsoon, they are turned into mud pools of dirty water and are rendered unusable.

India had in 1935-36 about 3 lakh miles of roads. They gave an average of about 1½ furlong of road for every square mile of area. About a quarter of this (82 thousand miles) comprised of metalled roads In 1951-52, India had 98,000 miles of metalled roads and about 151,000 miles of unmetalled roads During the First Plan period, about 20,000 miles of low-type roads are expected to have been added

The progress in road development is shown below·

Road Development

	Surfaced Roads	Unsurfaced Roads
Nagpur Plan Targets	123,000	208,000
April 1,1951	98,000	151,000
March 31,1956	122,000	198,000
March 31,1957	127,000	201,000
March 31,1961	144,000	235,000

More than half of the metalled road is in the peninsular India where the old hard rocks facilitate the building of such roads. Of the unmetalled roads on the other hand, about four-fifth (77 p.c) lies in the Indo-Gangetic Valley where the soft alluvium, the great distance from which the road-metal has to be obtained, and the frequent floods naturally favour the construction of the unmetalled road which is rebuilt cheaply after every rainy season Over most of the country 40% to 75% of the area is not being served by a road at all The following table gives the road mileage in some States of India:

States	Metalled Roads	Unmetalled Roads
Andhra	16,575	8,540
Assam	1,646	12,352
Bihar	5,473	30,442
Maharashtra and Gujarat ..	19,659	17,596
Madhya Pradesh.. ..	12,470	9,242
Madras	16,687	9,691
Orissa . ..	4,276	12,250
Punjab ..	5,042	10,096
Uttar Pradesh	11,935	35,200
West Bengal	6,058	18,072
Jammu and Kashmir ..	966	1,213
Mysore	14,179	8,991
Rajasthan	6,958	19,979
Kerala . ..	4,939	4,861

How poor is our road system compared to western countries is seen from the following table

Country	Road mileage Per one Lakh Persons.	Road mileage per Sq mile
Italy	376	0 89
U. K	381	2 02
France	934	1 84
W Germany	260	0 95
U S A.	2,411	1.03
Japan	728	3 0
India	73	0 22

It will thus be seen that total mileage of roads in India is far short of her requirements India has 20 1 miles of roads per

100 sq miles The comparable figure for U S A, U.K, and Japan are 100, 200, 400 miles respectively.

The total number of motor vehicles on the road during 1960 was estimated to be 598384 as compared to 294,727 in 1951-52 This number must be considered very small, having regard to the size of the country, its road mileage and its population The total number of automobiles was composed of the following.

Motor cycles	69364
Auto-Rickshaws	4960
Jeeps	26290
Private Cars	240370
Public service vehicles	50767
Motor cabs	18148
Goods vehicles	152938
Miscellaneous vehicles	35547

Privately owned automobile is the most widely used means of transport in U.S A, U K, France and Canada Every third person in U S A, every fifteenth in U K, every sixteenth in France and every eighth in Canada has an automobile, whereas there is only one vehicle for 1,350 persons in India Road transport is so elaborately developed in those countries that it is possible to reach almost every town or village by a motor bus

NAGPUR PLAN

A Ten-Year Plan for road development known as the 'Nagpur Plan' was drawn up in 1944 for an increase of road mileage from 265,000 to 4000,000. The Plan visualised the growth of a network of road communications at a cost of Rs 372 crores within 10 years The programme had to be curtailed owing to shortage of money, material and trained personnel. According to this Plan the Indian roads were to be divided into four classes. (i) National Highways, (ii) State Highways; (iii) District Roads; and (iv) Village Roads (i) The *National Highways* are to be frameworked for the country's road system These will connect capitals of states, ports and highways They also include roads of strategic importance. (ii) The *State high ways* are the main trunk roads of the state. (iii) The *District Roads* cannect areas of production and markets with either a highway or a railway. They also form the link between headquarters of neighbouring distrits (iv) The *Village Roads* mostly meet the requirements of rural population, they connect villages and group of villages with one another and with nearest district road or river ghat.

The *National Highways* include *Grand Trunk* Road from (i) Calcutta to Amritsar, (ii) Agra-Bombay Road; (iii) Bombay-Bangalore-Madras Road, (iv) Madras-Calcutta Road, (v) Calcutta-Nagpur-Bombay Road; (vi) Varanasi-Nagpur-Hyderabad-Kurnool-Bangalore-Cape Comorin Road, (vii) Delhi-Ahmedabad-Bombay Road, (viii) Road from Ahmedabad to Kandala Port with a branch road to Porbandar (ix) Hindustan-Tibet Road from Ambala to Tibet *via* Simla, (x) Delhi-Lucknow Road, (xi) Assam Access Road—Assam Trunk Road on the Sixth Bank of Brahmaputra and road branching off from the Assam Trunk Road towards Burma border through Manipur State

The national highway mileage in India is 14881 miles, distribueed as below:

Andhra	1412 miles	Madras	1050 miles
Assam	727 ,,	Maharashtra	1539 ,,
Bihar	1189 ,,	Mysore	816 ,,
Gujarat	676 ,,	Orissa	851 ,,
Jammu and Kashmir	338 ,,	Punjab	784 ,,
Kerala	260 ,,	Rajasthan	782 ,,
M. P.	1669 ,,	U P	1455 ,,
Delhi	44 ,	W Bengal	872 ,,
Himanchal Pradesh	200 ,,	Manipur	139 ,,
		Nagaland	69 ,,

During the Second Plan the total provision of Rs 246 crores has been made with this programme of investment, the target of road mileage under the Nagpur Plan be practically reached In addition to the works carried forward from the First Plan, the programme of National Highways will include the construction of 700 miles of missing links, and 40 major bridges and the improvement of 3,500 miles and widening of the carriage way on 3,000 miles of the existing sections In addition 1,150 miles will be constructed and over 500 miles upgraded. In the States about 21,000 miles of surfaced-roads and 37,000 miles of unsurfaced roads added during the Second Plan period.

WATER TRANSPORT

From ancient times, the trade and commerce of Northern India has been facilitated by the abundance of navigable streams and the flat topography of the countries History records evidence of a flourishing trade carried on along the rivers and canals of India from the earliest times The importance of waterways gradually diminished with the development of the railways with the result that the steamer service was gradually

withdrawn and country boat traffic also decreased So that new inland water transport is of minor importance. Its goods traffic being only 1% of that of the railways in terms of ton-volumeters The steamer traffic on inland waterways at present carries an estimated volume of 2½ million tons traffic only.

India is a land of many rivers, and yet water transport has not made much headway in this country. There are certain geographical draw-backs under which water transport has to labour in India (i) During the rainy season the rivers are in high floods and consequently have a strong current which is not easy to navigate During dry seasons, on the other hand, only the big rivers have water throughout their course, others become disconnected pools in which navigation is impossible

(ii) Even in the big rivers the water is very shallow and there are sandbars due to silting which further reduce the depth of the water There is a considerable distance of the dry bed of the river which must be crossed before coming to the water. Owing to the sandy nature of this bed vehicular traffic is almost impossible there. Over a large part of the country, thus, the towns on the rivers' banks cannot make use of the river transport fully Owing to the shifting rivers' course, it is not possible to make any permanent jetty or wharf on these rivers The multipurpose schemes under construction in certain parts of India may improve the navigability of some rivers.

(iii) Indian rivers usually enter the sea in shallow, sandy deltamouths, instead of broad and deep estuaries, which in western countries, offer, a pathway for ships for into the interior.

(iv) The upper reach of the rivers have been used for irrigation purposes and this hardly leaves any water for navigation for hundreds of miles below.

The mileage of water-ways in India is estimated to be about 41,000 miles Of these about 26,000 miles are rivers and 15,400 miles canals U P has 745 miles of navigable waterways, Bihar 715 miles. Bengal 777 miles, Assam 920 miles, Orissa 287 miles and Madras 1,700 miles Thus inland water transport is mainly confined to the States of Assam, West Bengal, Orissa, Bihar, U.P , Madras, Andhra and Kerala

The total length Block of waterways affording perennial navigation to steamers and country boats with drafts of 2 ft to 6 ft is estimated to be 5,750 miles. Of this total 3,000 miles represent navigable rivers and the rest the canals and back waters of the Malabar coast The navigable portions are 1 200 miles of the Ganga river system, 920 miles of the Brahmaputra river

system, 150 miles of the Hooghly river, 200 miles of the other rivers in West Bengal, 190 miles of Mahanadi, Brahamni and Baitarani rivers of orissa, 288 miles of Godawari river and 52 miles of the Krishna river. Of this total about 1,500 miles of Ganga-Brahmaputra river systems are navigable by steamers and the rest by country boats also

In Lower Bengal, Assam and in the river deltas on the east coast, however, there is enough water in the rivers and navigation is possible throughout the year These regions are not well supplied with railways or roads. This fact naturally makes navigation the only efficient means of communication. On the Ganga in Bengal and Bihar and on the Brahmaputra in Assam a large number of steamers, apart from the small country boats, ply to cope with the large amount of traffic that is diverted to the rivers The size of these steamers is limited by the minimum depth available during the dry season For about 500 miles from its mouth, Ganga maintains a nearly uniform depth of about 30 ft and so steamers can safely move upto the distance, although country boats proceed as far as Hardwar Ocean-going steamers come upto Calcutta on the Hooghly with the help of continuous dredging The current in the Ganga becomes sluggish in Bengal owing to the low height above sea level The rivers therefore, deposit silt with considerable speed Dredging has to be very active to keep the traffic channel in the river open

The Brahmaputra is navigable by steamers throughout the year and steamers run from the mouth to Dibrugarh It carries Assam oil, tea, timber and jute which are brought to Calcutta by having them transferred to road and rail system on the border of Pakistan Navigation is rendered difficult in this river because of the formation of new islands, sand banks and shoals, and the presence of a very strong current during the rains Steamer traffic on the Ganga and Brahamaputra is of the order of 625 million ton-miles, a year Countryboat traffic on these rivers is nearly twice as much.

Though a number of rivers are found in Deccan yet owing to their rock surface, they are navigable only in their lower courses and that too during the rainy season, when there is enough water in them Narbada, Tapti, Mahanadi, Krishna and Kauvery are such rivers.

The majority of the earlier irrigation canals were designed to combine navigation with their primary function of irrigation In the absence of serious railway competition in those days high hopes were held of the possibilities of utilizing these arterial waterways for navigation also. Communications were, at the time, both inferior and inadequate, and the new canals, pas-

sing as they did through fertile and populous country, appeared to offer a good opportunity for their improvement

It is now realised, however, that the combination of irrigation and navigation cannot, unless the circumstances are very special, be successfully effected. There are various reasons for this A canal designed primarily for irrigation must be aligned so as to afford command of a maximum area of cultivable land, without reference to the position of trade centres The traffic attracted is consequently very limited Moreover, in a highly cultivated tract large number of cattle are required for ploughing These cattle are available for carting the surplus crops to market at nominal cost to the owners This fact, therefore, militates against the extensive use of canals for carrying foodgrains. The Ganga Canal, which is navigable throughout its length and passes through one of the richest plains in India, fails to recover in tolls from the boats even the small extra cost of maintaining navigation upon it.

Some of the irrigation canals also allow small boats to ply The delta canals on the east coast are the most important for this, though some goods traffic passes on the Ganga canals also. Some of the irrigation canals in the Punjab allow timber logs to be transported in rafts The Sone canals also play an important part in navigation They carry generally low grade cargo mostly, sand, clay and stone, etc , from the Kaimur hills.

Navigation canals are even less important than the rivers The total mileage of navigation canals and back-waters in India is about 2,750, more than two thirds being in Bengal and Madras In the coastal districts of Bengal where no other means of transport is possible, canals are easy to build The large number of Bills or depressions full of water are easily inter-connected to provide a canal for navigation and for draining the land Bengal has, therefore, largest navigation canal mileage in India

The Buckingham Canal (on the east coast in Andhra Madras,) and the Orissa Coast Canal both let in sea water to provide sufficient depth for boats These two are the largest navigation canals in India.

The two most important navigable systems of irrigation works are the Godavari and the Krishna delta canals in Madras—which are 98 miles and 420 miles long respectively There are particularly strong reasons for using these canals for navigation. During many months in the year they carry away all, or nearly all the river water supply, and so cut off the upper waters of

the rivers from the seaboard They traverse flat and fully cuti-vated deltas in which there are no great falls to be overcome. These deltas are, besides, ill-provided with roads and other means of communication The lower ends of the canals are connected by the sea, the head of each system is connected with that of the other Thus, the upper waters of the Godavari and of the Krishna are connected with the Buckingham Canal The facilities provided are, in such circumstances, a great boon to the cultivators Yet even here it cannot be said that navigation is directly remunerative

The four canals, the Kurnool-Cuddapah canal (73 miles); the Orissa canal (170 miles), the Midnapore canal (287 miles) and the Sone canal (204 miles) are all navigable; indeed their primary object was navigation, but they are not a success.

The Buckingham Canal (258 miles) in Madras is a purely navigation canal. It runs parallel and close to the coast, joining up a succession of backwaters of the sea It extends for 196 miles north and 66 miles south of Madras town It joins with the Connanur canal of the Krishna Delta system.

The canal was open alike to river floods and to tidal flow and had no regulating works in the beginning Heavy silting naturally occurred in the channel and traffic was greatly impeded under these circumstances. Experience also showed that the alignment had been taken far too near the sea and was consequently subject to damage from high tides and storm waves. Accordingly, remodelling was undertaken in 1883 The canal was realigned in parts so as to take it out of back-waters and further from the sea An embankment, to protect it from waves, was also constructed along its eastern side Floodgates were fitted across the channel where it entered and left the various back-waters and rivers which it crossed in its course This was done to shut floods out of the canal After 1893, most of these flood-gates were replaced by a series of locks designed to retain a surface water level in the canal approximately upto the level of the highest prevailing tides

Through traffic from the Godavari and the Krishna deltas to Madras has now disappeared on this canal, owing to the building of the Calcutta-Madras Railway, which runs parallel and close to the Buckingham Canal The canal is now principally used for the transport of salt and firewood into Madras city from short distances south.

From the above description it would be clear that our inland water transport is not fully developed The following table gives the figures for inland waterways in some important countries of the world

Length of Waterways

Country	Total Length.	Length per 10,000 sq miles of land	Length per 1,000 persons
Netherlands	4,340	340 7	4 5
Belgium	1,054	91.0	1,25
Czechoslovakia	1 860	34 4	1 5
France	5,950	28 0	1 43
England	2,400	25 5	0 48
Germany	3,900	21 5	0 6
Poland	2,730	18 2	1 14
U S A.	28,000	9 8	1.95
Egypt	2,081	5 4	1 09
India	5,257	3 2	0 15

Hence, it becomes necessary to develop our inland water transport. A planned and co-ordinated development of cheap water transport is one of the principal solutions for meeting the increased traffic. Both in the interest of long-range development and the over-all economy of the country, water-transport deserves every consideration. Waterways and railways should be supplementary to each other because there is a natural division of traffic between the two "To the rail road goes the least burdensome traffic, which demands regularity and quick transit; to the waterways gravitate the heavy freights of small value, which can only be transported when freight are low " The development of water transport will not only remove the congestion of traffic from railways, but would also open up many new areas whose products cannot be at present moved because of high railway freights.

Fortunately the responsibility of further surveys, planning and development of waterways has been assigned to the Central Water and Power Commission, which has drawn up a master plan for developing inland waterways in the country. This envisages (i) the linking of Calcutta port on the east with Cochin in the west *via* Cuttack and Madras by a network of canals connecting some of the minor rivers of Orissa, Andhra, and Madras, (ii) a continuous waterway from Western India to northern and north-east India *via* Central India and a continubus waterway from the west coast to east coast through the hinterlands of Bombay, Madhya Pradesh and Andhra Pradesh.

The Ganga-Brahmaputra Water Transport Board (1952) has been let by the Government with the responsibility of improving the Ganga Brahmaputra river systems for navigation and to

extend it as far as possible This Board will co-ordinate and stimulate the navigational activities of the states of U P., Bihar, Assam and West Bengal situated on this river system. Under this Board, plans are now afoot for starting a pilot project with uptodate craft for towing barges on the shallow stretches of Upper Ganga between Patna and Allahabad.

The new multi-purpose projects include the following schemes for navigation channels

(a) U P

(i) Resuscitation of the Goghra river up to Barhamghat to extend navigational facilities

(ii) Ravival of navigation of the Ganga upto Allahabad and the development of navigation in the Yamuna River upto Etawah

(iii) The flood control on Betwa and Chambal to provide an ample discharge in the Yamuna during the dry season which may permit navigation on the Yamuna

(b) *West Bangal*

(i) The construction of a navigation Canal from Durgapur to Hooghly under the D V C , to connect the coalfields of West Bengal and Bihar with the port of Calcutta

(ii) Resuscitation of the Bhagirathi route affording direct and shorter connection with Calcutta port by the construction of a Barrage on the Ganga (which is still under the consideration of the Central Govt) The objectives of this barrage are: (i) construction of the Barrage across the Ganga in the border of Bengal-Bihar, (ii) the provision of a greater volume of water in the Bhagirathi and other rivers of West Bengal, (iii) the navigable route between Calcutta and the Ganga; and (iv) conservation of the river Hooghly for the benefit of Calcutta by bringing down sufficient head water

With the completion of this project, the Bhagirathi will become navigable throughout the year, and the salinity of the river Hooghly will also be reduced by the continuous flow of water of the Bhagirathi

(c) *Assam*

Resusitation of the various tributaries of Brahmaputra—Dihing Dibu, Dhansiri and Kalung—in the upper Assam Valley.

(d) *Orissa*

(i) The Mahanadi Valley Project provides for navigation on the Mahanadi River in Orissa upto 200 miles from the sea and

connecting the hinterland with Pradip—10 miles up the Mahanadi from its fall into the sea.

(ii) The Orissa Coastal Canal together with an extension of the Mahanadi Delta system, thereby affording direct inland navigation from Assam to Madras

(e) *Bihar*

(i) Resusitation of the Gandak and Kosi rivers and their tributaries

(ii) Extension of navigation in the Sone river for about 150 miles as visualised in the Sone River Project

(f) *Madhya Pradesh*

The Narbada and Tapti multi-purpose projects including navigation are under consideration of the Govt.

(g) *Bombay*

Kakrapar Project in the State will provide navigational facilities from the sea to Kakrapar Dam and 50 miles further land

(h) *Madras and Andhra*

The proposed works on the Godavari, the Krishna, the Pranbita and the Wain Ganga will provide navigation facilities.

SHIPPING

India has about 3,500 miles of coast line but her shipping industry is insignificant when compared to those of great maritime powers Indian shipping having 9 05 lakh gross registered tonnage is about 0 52% of the world tonnage It is adequate to carry the entire coastal, about 40% of the adjacent and about 5% of the overseas trade Her coastal vessels carry about 2 million passengers a year, while about 200,000 overseas passengers travel by Indian ships.

The Shipping Policy Committee of 1947 laid down the following objectives for Indian shipping with a view to secure 2 million tons in near future, thereby securing the Indian shipping—(1) 100 per cent of the coastal trade of India, (2) 75% of India's trade with Burma, Ceylon and other neighbouring countries, (3) 50% of India's overseas trade and (4) 30% of the Orient's trade The First Plan envisaged a rise in India's shipping tonnage from 390,707 GRT to 600,000 GRT by 1956 In the Second Plan, 3000,000 GRT are expected to be added so that the total tonnage would be 900,000 GRT by 1960-61 With the achievement of this target Indian tonnage is expected to carry about 12 to 15% of the country's overseas trade; 50% of

her trade with adjacent countries as against the present proportions respectively of 5 and 40 percent

The Central Govt. have taken the following steps to encourage the development of Indian shipping:

1 Reservation of coastal traffic for Indian ships only since 1950. The aggregate quantity of cargo in dead weight tonnes carried on the coast was 24 49 lakhs in 1951 and 28 49 lakhs in 1954 While all coastal cargo is now carried by Indian ships, the Government have also negotiated with foreign shipping interest and ensured for Indian Shipping a fair share of the trades with Burma, Ceylon and Pakistan

2. The Government also grants loans for the purchase of necessary shipping requisites *e g.*, the private sector has received loans to the extent of Rs 24 crores during 1951-56, and Rs 12.5 crores for 1956-61 for adding to their fleet 37 ships (totalling about 68,000 GRT) will be aided under this aid.

3 Sale of ships built at the Hindustan Shipyard at the U K parity prices.

4 Allotment of Government owned and or controlled Cargo.

5 Sponsoring admission to Industrial Conferences.

6 Establishment of two State Shipping Corporations The Eastern Shipping Corporation was set up in 1950 It owns 8 vessels totalling 42,293 GRT and has regular services to Australia, East Africa, Malaya and Japan and passenger *cum* cargo service on the India-Singapur and India-East Africa routes It also runs the India-Andaman service The Western Shipping Corporation was set up in 1956 and it functions along the Indian —Persian Gulf, India—Red Sea, India—Poland and India—Russian routes.

OVERSEAS SHIPPING

It is estimated that Indian Liner Companies between themselves do not carry more than 5 per cent of the overseas trade The total tonnage employed by Indian Cos in the foreign trade is about 371,763 GRT. The five Indian Cos. are now operating in foreign trades and their total gross tonnages are:

(1) Scindias—197,288 G R. T.

(2) India Steamship—73,293 G R T

(3) Bharat Lines—64,849 G. R. T.

(4) Great Eastern Shipping—38,167 G R.T.

(5) Western Shipping Corporation Ltd.

(6) Jayanti Shipping Corporation

Though the Indian Government has endorsed the policy of Indian shipping carrying at least of 50% of India's trade in international waters, there are a number of handicaps which Indian shipping will have to cross for carrying this much Indian overseas trade.

(i) A large number of Liner Conferences dominate these trades. Entry into such Conferences is not easy matter Indian Lines have not yet been admitted to membership of a number of conferences in the waytrades on the main trade routes between India and U K. and India and the Continent such as Colombo—U K.; U K —Colombo, Colombo—Continent, U K—Aden and U.K.—Port Said Conference

(ii) Indian Shipping Cos. will have to expand their tonnage on different lines where they do not go at present.

(iii) The Passenger services should be opened with modern amenities

At the end of November 1961, 175 ships totalling 9 05 lakh GRT were on the Indian Register—100 ships of 3 43 lakh GRT on the coastal trade and 75 vessels of 5.62 lakh GRT on the overseas trade Indian vessels ply on six overseas routes, as said above On four of the six routes, the ships carry cargo and on the two cargo as well as passengers

AIR TRANSPORT

Air transport is the least important of the means of communication in India at present India has a strategic position on the Air route to Australia The main lines between Europe and Australia have to pass through India

There are in the Indian Republic 84 airports; of these Dum Dum (Calcutta) is the biggest airport in Asia Airports of Calcutta, Bombay and Delhi are on the International Air Routes The airports are a few miles away from the main cities; *e.g*, the airports of Delhi are at Palam and at Safdarganj, of Calcutta at Dum Dum and Barrackpore, of Bombay at Santa Cruz and Juhu, of Madras at St. Thomas Mount, of Allahabad at Bamrauli, and so on

Delhi, Bombay, Calcutta, Madras, Tiruchirapalli, Vishakhapatnam, Agartala, Ahmedabad, Patna, Bhuj, Jodhpur and Amritsar are the customs airports where taxes are paid on imported goods by the passengers

Six new aerodromes at Haldwani (U.P) Kandla, Tulihal (Manipur), Raxual (Bihar), Jogbani (Bihar) and Behala (Bengal) have been completed.

Besides the airports, there are a number of airstrips for landing and take off of the planes The Government of India

is spending about half a crore of rupees every year on these airports and strips

Indian aircrafts flew about 290 lakh miles carrying about 8 lakh passengers and nearly 1,942 lakh pounds of cargo and mail on scheduled services and non-scheduled services taken together during 1958

During 1961 (estimated) Indian aircraft flew about 331 lakh miles carrying about 10 6 lakh passengers and nearly 1822 lakh pounds of cargo and mail on scheduled services and non-scheduled services taken together

The scheduled air transport services flew 27452000 miles in 1961 as against 24742000 miles in 1959 The number of passengers and freight carried increaed from 736000 and 73877000 lbs respectively in 1959 to 948000 passengers and 88359000 lbs of freight in 1961 The mail carried by scheduled services showed remarkable increase in 1959 at first that of 1958, and after a slight decrease in 1960 there was further increase in 1961 In 1958 the mail carried by scheduled services was 13608000 lbs, in 1959, 15049000 lbs, in 1960, 15029000 lbs and in 1961—1622800 lbs

During 1959 nearly 5578000 miles were flown on non-scheduled operations against 1958 figure of 4997000 miles In 1960, 6161000 miles were flown but in 1961 only 56,57000 miles showing decrease The number of passengers and cargo carried were approximately 89000 and 81142000 lbs respectively in 1959, and 88000 and 85784000 lbs respectively in 1960 For 1961 the estimated figures were 111000 passengers carried and 77585 000 lbs freight carried.

The introduction by Air-India International of a weekly scheduled service in each direction between Delhi and Moscow, *via* Tash kent, was an important development in the field of international air transport services A scheduled weekly cargo service between India and U K has been introduced A scheduled halt at Djakarta was provided on the service operated between Bombay and Sydney and the frequency of the Bombay-Tokyo service was increased from two to three times a week

The progress of air transport in India is shown by the following table.

Year	Miles flown	Passengers carried	Freight carried (lbs)
1947	13,413,000	287,000	8,641,000
1951	26,112,000	515,000	219,289,000
1956	29,216,000	673,000	193,320,000
1957	28,054,000	741,000	174,394 000
1958	29,575,000	795,000	177,841,000
1959	30,320,000	825,000	150,019,000
1960	30,933,000	921,000	153,858 000
1961	33,100,000	1060,000	182,200,000

Since 1947, the passenger traffic has more than double, the cargo loads have gone up more than 17 times, mail loads about 9 times and miles flown about 2½ times

Airways in India depend for their success largely upon the mails that they carry[1] It will, therefore, be right to give the story in brief of the improvement and development of air mail in India.

In April, 1929, was started the first regular Air Mail Service from India A direct air mail service was established between England and India, and mails for most of the countries in Europe and for Iraq, Palestine, Egypt and Persia were sent by this service The Indian State Service, a State-owned air mail line was established in December, 1929, between Delhi and Karachi to connect with the Imperial Airways Service between India and England This service was operated by the Delhi Flying Club from January, 1932

In 1930, the Royal Dutch Air Company established a fortnightly service between Holland and the Dutch East Indies across India A French Air Company also began to operate in the same year, the Marseilles-Saigon Air Services across India These services dropped mails for India at the frontier posts of entry and were not allowed to carry internal India traffic In 1932, however, it was decided to use both services for the carriage of Indian foreign mails to places which were not served by the British air services.

An air parcel service was introduced between Great Britain and Northern Ireland and India in May, 1931, and in July an air mail postcard service was also introduced An air mail postcard, first of its kind in the whole world, was put on sale to the public, bearing a stamp and a blue air mail label printed thereon

In January, 1932, the Cairo-Mwaza Air Mail Service of Imperial Airways was extended to South Africa and the first despatch of the air mails from India for South Africa was made form Karachi on 20th January, 1932

[1] *The Mails carried by Air*

Year	Weight in lakh lbs.	Year	Weight in lakh lbs
1947	14	1955	114
1948	16	1956	127
1949	50	1957	129
1950	83	1958	132
1951	72	1959	150
1952	83	1960	150
1953	88	1961	7534*
1954	107	1962 (estimated)	7926*

*Weight in thousand kilograms

A feeder service was started in 1932 between Karachi, Bombay and Madras connecting at Karachi with the London-Karachi service This was made possible through the enterprise of the Tatas Limited under a ten-year contract with the Government of India The internal service between Delhi and Karachi maintained by the Delhi Flying Club ceased to operate from 4th July, 1933 A new Company, called the Indian Trans-Continental Airways Limited, working in conjunction with the Imperial Airways Limited started from 7th July, a weekly air mail service between Karachi and Calcutta The service was extended to Rangoon *via* Akyab from 1st October, 1933, and to Singapore from 15th December, 1933

The Indian National Airways Limited introduced from 1st December, 1933 a daily mail and passenger service between Calcutta and Dacca and a weekly service between Calcutta and Rangoon The Madras Air Tax Service started from 10th February, 1934, a bi-weekly air mail service between Madras and Calcutta Later on, however, these services ceased to operate A new weekly air mail service was started from December, 1934, between Karachi and Lahore, the service being operated by the Indian National Airways Limited This service was later duplicated

In 1935 increased facilities for the transmission of correspondence were provided The service between Calcutta and Singapore was duplicated and operated jointly by Imperial Airways and Indian-Continental Airways A connection was established at Athens between the westbound places from Karachi and the northbound places of the Greece-Germany Air Service. Use began to be made of the air service operated by Imperial Airways between Khartoun and Kano (Nigeria) for the despatch of air mail to West Africa A new weekly air service was established towards the end of 1935 by Tata Sons Limited for operation during May between Bombay and Trivandrum.

Since 1935 air mail correspondence for places in the United States began to be accepted for despatch by the internal air service in that country Correspondence for South America also was accepted for transmission by air *via* Gearmany or France.

In 1936 the service between Singapore and Australia was duplicated, the Khartoum-Kano weekly service was extended to Lagos and a weekly air mail service was introduced between Penang and Hong Kong.

Another internal air service was opened between Bombay and Delhi in November, 1937, and yet another from Bombay to Kathiawar in November, 1938 Simultaneously with the introduction of this scheme, the frequency with the internal feeder

services, namely, Karachi-Madras and Karachi-Lahore was increased first to four and then to five times a week. Karachi-Madras service was extended to Ceylon and Bombay Trivandrum service to Trichinopoly to connect with the Karachi-Colombo service.

After partition, the Air Communication in India was reorganised Delhi was now connected to Bombay from where planes took off for Europe The foreign companies still make use of Karachi for this purpose.

From June 1, 1951 the Deccan Airways, recently taken over by the Government of India, commenced operating the Night Air Mail service when their first Nagpur-bound planes took off from the Dum Dum airport with about 100 bags of mail and 13 passengers.

From August 1, 1953 the Government nationalised all air transport in India All the eight companies for inland operation were formed into the Indian Air Lines Corporation Those working in the international air transport were organised into the Air-India International Corporation The advantages of nationalisation can briefly be listed as follows

(1) The available resources in equipment, workshop capacity and technical personnel would be used to the maximum benefit

(2) From the point of view of defence, operation of all air services by a State organisation would obviously be the most desirable arrangement

(3) Air transport is a public utility and ought to be developed to serve national interests

(4) Rapid developments are taking place in the techniques of civil aviation and only a State organisation can command the resources to take the fullest advantage of these technical developments

The two Corporations Indian Air Lines Corporations and Air India International came into existence on 15th June, 1953. The Air India International took over the business of the Air-India International Ltd, while India Airlines Corporation took over as a going concern, the assets, liabilities and business of eight units, namely, Airways (India) Ltd, Himalayan Aviation Ltd, Kalinga Airlines, Bharat Airways Ltd, Air-India Ltd Air Services of India Ltd, Deccan Airways Ltd, and Indian National Airways

INDIAN AIRLINES ROUTES

Frequent air services are available along the two coasts (i) From Colombo through Madras—Vishakhapatnam—Bhubneshwar to Calcutta in the east, and from Trivandrum through Cochin—Mangalore Bombay to Jamnagar, Bhuj on the west coast

(ii) Through the interior: linking Madras and Bombay with Bangalore, Hyderabad and Poona, Bombay and Calcutta with Varanasi, Lucknow and Nagpur

(iii) In the far north from Delhi to Srinagar.

(iv) In the east between Calcutta and Imphal and other parts in Assam

Other Indian Airline routes bring country's nearest neighbours within a few hour's flight, as between Delhi and Karachi *via* Jaipur and Jodhpur, Delhi and Lahore; Calcutta and Dacca—Chittagong; Patna—Kathmandu in Nepal Another 'neighbour' service links Kandahar and Kabul in Afghanistan with Karachi and Delhi or Bombay

The Indian Airlines Corporation with its fleet of 97 aircrafts links up most of the principal centres in the country, and its air routes cover a total mileage of 22,700 Its aircraft carried 599,573 passengers and flew a total of 183,18,552 miles during 1957-58 The services of Indian Air Lines Corporation units radiate from important centres like Madras, Bombay, Calcutta, Agartala, Delhi and Srinagar The important air routes are

(i) *Madras*

(1) Madras—Trivandrum—Madras

(2) Madras—Hyderabad—Nagpur—Delhi

(3) Madras—Nagpur—Delhi (Night air mail service)

(ii) *Bombay*

(1) Bombay—Poona—Hyderabad—Bangalore, (2) Bombay—Nagpur—Calcutta (Night air mail service), (3) Bombay—Karachi—Bombay, (4) Bombay—Ahmedabad—Bhuj—Karachi, (5) Bombay—Bhavnagar—Rajkot—Jamnagar—Bhuj, (6) Bombay—Keshod—Porbandar—Jamnagar, (7) Bombay—Belgaum—Mangalore—Cochin, (8) Bombay—Calcutta—Bombay, (9) Bombay—Colombo-Bombay and (10) Bombay—Delhi—Bombay

(iii) *Calcutta*

(1) Calcutta—Gauhati—Tejpur—Jorhat—Mohanbari, (2) Calcutta-Gauhati—Jorhat — Lilabari—Jorhat — Passighat, (3) Calcutta—Agartala—Gauhati—Silchar, (4) Calcutta—Agratala, Gauhati—Khavai—Kamalpur — Kailashahar — Silchar—Imphal, (5) Calcutta—Bangalore—Calcutta; (6) Calcutta—Dacca—Calcutta, (7) Calcutta—Chittagong—Calcutta, (8) Calcutta—Rangoon—Calcutta, (9) Calcutta—Bangdogre—Calcutta

(iv) *Delhi*

(1) Delhi-Calcutta—Delhi, (2) Delhi—Lucknow—Gorakhpur—Varanasi—Patna—Calcutta; (3) Delhi—Srinagar—Delhi, (4) Delhi-Lahore—Delhi; (5) Delhi—Karachi—Delhi; (6) Delhi—Amritsar—Kabul, (7) Delhi—Agra—Gwalior—Bhopal—Indore—Aurangabad—Bombay; (8) Delhi—Bikaner—Jodhpur—Ahmedabad—Rajkot

EXTERNAL AIR ROUTES

In the field of international air transport Air India International has made good progress Air India International with its fleet of 10 aircrafts provides services reaching out to 19 countries and covering a total route-mileage of 23,483 During 1957-58, it carried 88,312 passengers on its service and its aircraft flew over 67,19,000 miles There are four weekly services between India and the U K , twice-weekly services between Bombay and Nairobi and a service between Bombay and Singapure *via* Madras • Regular external services are being maintained to Cairo, Rome, Paris, Geneva, London, Aden, Nairobi, Bangkok, Singapore, Ceylon, Burma, Nepal, Pakistan, Afghanistan and Australia Several foreign airlines have air services in the Indian Union These foreign lines are

(1) Air Ceylon Ltd , Madras

(2) Air France, Calcutta, Bombay, New Delhi

(3) B O A C—Bombay, Calcutta, New Delhi

(4) Cathey Pacific Airways, Calcutta

(5) K L M|Royal Dutch Airlines, Bombay, Calcutta, Madras, New Delhi

(6) Pakistan International Airlines Corporation, Bombay, Calcutta, New Delhi

(7) Pan American World Airways, Bombay, Calcutta, Delhi

(8) Qantas Empire Airways Ltd, Bombay, Calcutta, Madras, New Delhi

(9) Scandinavian Airlines System, Bombay, Calcutta, Madras, New Delhi.

(10) Thai Airways, Calcutta.

(11) Union Aeromaritime De Transport, Calcutta.

(12) Union of Burma Airways, Calcutta.

(13) Trans-World Air Lines.

NIGHT MAIL SERVICE

Mention may be made of Indian Airlines' operation of the Night Airmail System. Every night four I A C crafts fly between Bombay and Nagpur, Madras and Nagpur; Calcutta and Nagpur and Delhi and Nagpur Letters, packets and parcels are redistributed at Nagpur, then flown back to the four main cities

QUESTIONS

1 What are the geographical causes of India's backwardness in transport facilities?

2 Discuss carefully how the physical features of India control the building of roads and railways.

3 To what extent has water transport been developed in India? What are the geographical difficulties in the way?

4 What are the main air routes in India? What geographical factors, if any, control these routes?

5 What is the position of the Indo-Gangetic Basin in India in respect of:

(a) Road transport,
(b) Railway transport, and
(c) Water transport.

Chapter 11

Trade

Trade is a symptom of civilization The economic progress of a nation or an individual is based upon trade. One nation or individual exchanges its surplus production for the surplus of another nation or individual In this way, everybody tends to produce only that commodity for which nature has given him the greatest capacity Climate, topography and social organisation determine the capacity for production They also, on the other hand, determine the needs (in other words market) for commodities The origins of trade are thus the function of geography.

India contains a little more than one-fifth of the total population of the world Yet, the poverty of her people prevents her having a large trade The total foreign trade of India is less than that of Great Britain whose population is only about one-sixth of India's Even the internal trade of India is far below the standard expected in modern times from a country with such a large population The smallness of India's trade is due to her low production We have noted in this book our backwardness in agriculture, as well as in industries We do not produce enough, and unless we produce enough, we cannot have large quantities of goods for exchange or be rich India's problem is, therefore, one of Production first and of Distribution second

India is essentially an agricultural country, and her trade, both internal and external, must be characterised, therefore, by the movement of heavy commodities The paucity of roads and railways is a great drawback in this respect The difficulties of transport limit the markets for Indian produce. The building of railways and roads in India, and the cutting of the Suez Canal across the Isthmus of Suez opened up new markets for India's agricultural products With her increased exports, India could now buy larger quantities of goods produced in the world especially in Europe The trade began to grow considerably in volume, therefore, since the last quarter of the 19th century

The foreign trade of India is of great significance, for it is this which provides the country machines, chemicals raw materials and manufactures without which we cannot progress.

The following are the salient features of our foreign trade

1. Our foreign trade is carried mostly by sea.

The yearly average of the total sea-borne trade of India in merchandise on private account alone amounts of Rs 350 crores.

2 The per capita share of the foreign trade of our country is much lower than in Europe or America or Japan

Per capita foreign trade in India and some important countries is given below 1956 (in U S Dollars)

Canada	444	France	146	Egypt	40
Australia	415	U. S A.	131	Iraq	165
Denmark	349	W Germany	71	Israel	258
U. K.	305	India	8	Turkey	29
Japan	17	Pakistan	11	Cyprus	327

3 During the war and post-war years, in the composition of India's foreign trade, the share of imports of raw materials is on the increase while the share of exports of raw materials to the total exports have declined This situation can be accounted for two reasons *Firstly*, as a result of partition, India lost many of her raw material markets like cotton, jute, foodgrains, *Secondly*, industrial development as a result of plans has necessitated the heavy imports of raw materials as well as the increased use of domestic raw materials In exports we have lost heavily in raw jute, raw cotton, oilseeds, shellac, hides and skins, tobacco and spices.

4 The imports of manufactured articles are steadily declining but their exports are on the increase This change is due to India's policy of encouraging exports of manufactured articles and partly due to a relative improvement in the industrial position of the country.

5 Our trade is now increasing with U S A., Australia and other Far Eastern Countries and that with U K. is on a decline

6 For some time past our balance of trade has been unfavourable as would be clear from the following figures:

Balance of Trade in Lakhs of Rs

1950-51	22,01	1956-57	229,13
1951-52	238,24	1957-58	400,59
1952-53	124,52	1958-59	235,50
1953-54	76,61	1059-60	206,00
1954-55	63,91	1961-62	429,50
1955-56	116,50	1962-63	383,50

The foreign trade of India has undergone many changes during the last few years, owing to the effects of the World War and the partition of the country. The export and import of commodities is no longer completely free Licences are now required for this purpose from the Government The control of our foreign trade has been necessitated.

(a) because there is a shortage of some raw materials in the country, *e.g* raw cotton and raw jute, and, therefore, their minimum supplies for home use must be guaranteed.

(b) because there is a shortage of dollars in the world, and, therefore, exports to dollar areas must be encouraged For it is with the dollars that a large part of our food, our machinery, and other manufactured articles are paid for

(c) because our resources of foreign exchanges or money with which we pay for our imports are limited, and, therefore, we cannot import as well like.

In this respect, it is important to remember that the currencies of the world are divided today into *hard currency* and *soft* currency The dollar (Aemrican currency) represents the *hard*, and the £ sterling (British currency) the *soft currency*. Export to the hard currency areas and imports from the soft currency areas are to be preferred The payment for the imports is made with the exports commodities or labour or foreign money. As the hard currency areas export more to other countries than they buy from them, therefore these other countries are always anxious to get dollars from any source they can to pay the hard currency areas. This fact has, therefore, led to the control of foreign trade in all the soft currency areas.

The following table shows our trade with Sterling and Dollar areas since 1952-53.[1]

Year	Sterling Area		Dollar Area		O E E C Countries		Rest of non-Sterling Areas.	
	Imps.	Exps	Imps.	Exps	Imps.	Exps.	Imps	Exps.
	(In crores of Rs)							
1952-53	272	292	214	139	99	66	85	80
1954-55	331	335	101	115	134	65	88	79
1955-56	298	310	98	110	157	81	126	96
1956-57	333	313	116	112	225	65	159	109

1 *Reserve Bank of India Bulletin*, March, 1959 p 409.

During the Second World War trade control became very much marked, due to war requirements. After the War the control was necessary for economic rehabilitation in India, the creation of Pakistan complicated this issue considerably But in order to expand trade without detriment to internal requirements export controls were liberalized in 1949. They had been in force since the War because of the internal shortage of goods. Subsequently, they were found helpful in developing exports and thus earning foreign money. In 1950, certain restrictions had to be imposed against the exports However, after the heavy adverse balance of our foreign trade in 1949, the emphasis was shifted from export control to export promotion.

In recent years India has imported more than she has exported. The value of the foreign trade of Indian Republic is given below:

(In crores of Rupees)

Trade	1950-51	1955-56	1960-61	1961-62	1962-63
Imports	581	653	1003 2	1090	1077
Exports	579	597	648 3	660 5	700·1*

The following table shows the most important items of the import trade in crores of Rupees :

Foreign Trade of India (In crores of Rupees)

Year	Imports	Exports with re-exports	Total value	Balance of Trade
1950-51	650 46	600 68	1,251·14	— 49·78
1955-56	774 36	608 83	1,383 19	— 165 53
1960-61	1,122 48	642 32	1,764·80	— 480 16
1961-62	1,090	661 99	1,702 06	— 378·08
1962-63	1,077	694 00	1,133.82	— 233 10

(Value in lakhs of Rupees)

Exports .

	1960	April-Nov. 1962
Tea	123,59	84,97
Cotton Fabrics .	57,54	29,36
Textile fabrics (other than cotton)	79,71	71,03
Textile articles (other than clothing and footwear) ..	61,23	41,30
Crude minerals (excluding coal, petroleum, and fertilizer materials)	12,71	19,01

*Including exports from. Goa

Ores of non-ferous base metals and concentrates	16,49	6,14
Leather . ..	24,85	14,65
Raw cotton	8,67	7,17
Fruits and inedible vegetables materials	21,49	14,15
Raw wool . ..	7,72	4,88
Sugar	3,28	12,45
Iron ore and concentrates . .	17,03	12,09
Tobacco unmanufactured ..	14,61	13,62
Vegetable Oils	8,54	6,89
Iron and Steel	9,68	1,65
Coffee	7,22	5,71
Hides and skins, raw ..	10,02	8,83
Petroleum products ..	4,07	2,80
Coal, Coke and briquettes ..	3,33	2,03

Imports :	1960	April-Nov 1962
Machinery other than electric	203,37	167,71
Iron and Steel .	122,54	52,72
Petroleum Products .	52,07	36,82
Transport Equipment	72,39	34,38
Electric machinery and apliances	57,22	36,78
Raw cotton	81,74	42,42
Wheat unmilled . ..	153,20	45,35
Petroleum, crude and partly refined	17,36	18,30
Chemical elements and compounds	39,34	26,18
Manufactures of Metals .	20,37	11,73
Textile yarn and Thread	14,37	8,86
Copper .. .	21,93	15,40
Rice . ..	22,11	16,62
Medicinal and pharmaceutical products	10,50	6,81
Raw wool & hair	10,41	7,83
Paper and paste board	11,83	7,35
Coal-tar, dye-stuffs and natural indigo	9,85	5,97

Where we look at the geographical distribution or the direction of our foreign trade, we note that the largest share of this trade is with United Kingdom and U S A The largest share of our imports (26%) and the largest share of our exports (31%) in 1957 was accounted for the United Kingdom. The U S.A came next with 12% and 15%, Australia, Egypt, Iran, Italy and Japan are other important countries in our foreign trade.

The following table gives the values (crores of Rs.) for 1952 and 1961 of the import and export trade:

Country	Imports From 1952	Imports From 1961	Exports to 1952	Exports to 1961
U. S. A.	272·6	240 0	116·5	114 4
U K	148 9	200·0	125 7	162·9
W. Germany	24 2	122 0	12·4	21 3
Iran	—	31 3	—	—
Japan	19 4	60·7	25 2	40 2
Italy	11·4	24 0	10 4	9 6
France	13·0	16 3	5 9	8 2
U S. S R.	—	25 4	—	31 0
Australia	15 1	17 6	23 4	16.5
Federation of Malaya	—	12 5	—	—
Canada	29·6	17·4	12·7	17 4
Pakistan	29 1	11 5	47 3	9·8
Burma	31 0	8 4	23 5	5 8
Egypt	20 1	10·3	6 5	12.1

India has the largest trade with the United Kingdom not only because we had been under the British rule in the past but also because Britain owes us money on account of the last World War This money is known as the 'Sterling Balances'. We can get back this balance only in the form of goods.

Britain supplies us mainly manufactured articles, and buys from us raw materials and tea The following tables show the contents of our trade with Britain

INDIA'S TRADE WITH U K.

Principal Exports To

(Figures in £ thousand)	Full year 1954	Full year 1957
Total of All Exports	148,595	157,571
of which,		
Tea	76,963	84,342
Leather, leather manufactures and dressed furs	13,271	13,348
Tobacco and Tobacco manufactures	6,910	7,141
Hides, Skins and Furs, undressed	974	—
Wool and other animal hair	55,67	4,576
Cotton	2,584	2,263
Miscellaneous textile fibres and waste	1,070	1,137
Metalliferous ores and scrap	3,081	4,559
Miscellaneous animal and vegetable crude material, inedible	4,528	4,370
Animal & vegetable oils, fats greases & derivatives	1,892	3,743
Miscellaneous textile manufactures	16,442	12,105

Principal Imports from U. K. (1954 & 1957)

	Thousand	
Total All Imports	£114,907	176,415
of which .		
Machinery other than electric	28,001	45,502
Electric Machinery, Apparatus, etc	14,836	21,973
Wool and other animal hair	4,929	6,087
Petroleum and Petroleum products	4,610	2,266
Chemicals	15,127	16,561
Paper, Pasteboards and manufactures	1,331	1,658
Iron and Steel	5,891	13,280
Non-ferrous base metals	1,653	3,105
Manufactures of metals	5,080	17,262
Railway Vehicles	3,052	5,559
Road Vehicles and Aircraft	9, 363	21,037
Scientific Instruments, photographic and optical goods · Watches and Clocks	2,239	2846

INLAND TRADE

In a country as big as India with the vast population, inland trade naturally assumes gigantic proportions India, however, suffers from a great drawback in this respect Her network of communications is not complete There are extensive areas in India without any road or railway In spite of this drawback, large quantities of goods are transported over different parts of the country. Before the War, foodgrains of different classes (rice, wheat, barley, millets, maize, gram and pulses, etc) formed the most important item of the inland trade of India Most of these grains travelled only short distances, as they are cheap and bulky and cannot, therefore, stand high cost of transport.

The following table shows some of the important commodities entering into the inland trade of India by rail and rivers (in million maunds) :

Commodity	1951-52	1955-56	1959-60
Coal and Coke	541	580	713
Raw Cotton	12	7	4
Cotton Piecegoods	6	8	8
Rice	22	22	62

Wheat	52	54	69
Raw Jute	12	9	16
Iron and Steel goods	46	51	78
Oilseeds	22	25	25
Salt	39	30	35
Sugar	17	22	22

The following table gives the Railway-Traffic-Wagon Loadings

(In Thousands)

	1952-53	1955-56	1956-57	1957-58
Coke and Coal	2,635	2,772	2,165	2,389
Grains and Pulses	949	972	1,023	1,225
Oilseeds	171	212	219	214
Raw Cotton	108	110	108	104
Cotton manufactures	61	67	58	42
Raw Jute	188	150	207	217
Jute manufactures	21	29	24	25
Sugar	169	170	196	216
Cement	297	412	427	504
Pig Iron	25	41	30	39
Iron and steel	260	331	389	476
Tea	46	48	52	47
Manganese ore	156	148	180	194
Iron ore	325	387	473	349
Others	6,002	6,912	7,935	8,294
Total of Wagons Loaded	11,413	12,761	13,586	14,335

IMPORTANT PORTS

Practically all the foreign trade of India passes by sea, because the countries on her land frontier are poor and inaccessible and neither buy nor sell much This sea-borne trade is concentrated only on a few ports of India Calcutta, Bombay and Madras handle almost the whole of the sea-borne trade of India. There are, however, a number of small ports both on

the west coast and the east coast of India which handle a large amount of this foreign trade as part of the coastal trade

The geographical factors determining the port sites on the western and esatern coasts are somewhat dissimilar On the west coast from Cape Monze to the little town of Bulsar the coastal plain is low over extensive areas, its general flatness being broken only by the volcanic hills of Kutch and Saurastra and the Girnar Hills of crystalline rock, also in Saurastra. There are two conspicuous features on this section of the coast, (1) The Rann of Cutch, and (2) the Gulfs of Cutch and Cambay.

The Rann is dry and passable by during the winter months, but invaded by the sea at the outset of the Monsoon.

One of the most important factors in the geography of the west coast of India is the sedimentation, for it has played a very important part in various ways in determining port sites The general trend of currents impinging on to this coast is from the west, and as the currents set into the Rann and the Gulfs of Cambay and Cutch, they have the effect of increasing the degree of sedimentation. Owing to the fact that strong currents set in, in an easterly direction past the mouth of the Indus, the silt from that river is carried into the Gulf of Cutch and Rann, while currents setting into the Gulf of Cambay prevent the free movement of Tapti and Narbada silt out of the Gulf The result is that these regions have been silting areas for a long time It has been estimated that the channel approach to Bhavnagar has silted as much as 40 ft in the last 50 years

There is a striking contrast between this section of the coast and that which lies to the south of Cambay It is mostly low and possessing a flat, deeply indented coast, the extensive gulfs contain waters which are difficult to navigate either by reason of insufficient depths or roughness, while the creeks provide poor harbours because of their tendency to become silted, or because distributories may forsake them South of Bulsar the Deccan Trap occurs The coast becomes rocky and island strewn, and the narrow coastal plain, varying in width from 70 miles in the north to under 30 miles in the south, is overlooked by the steep escarpment of the Western Ghats These features continue southwards until in the extreme south a low swampy coast is again found in the silted Cochin lagoons

The low coasts on the west have a rainfall below 50 inches, the middle section has from 50 to 100 inches, while the southern area of metamorphic rocks and lagoons has over 100 inches

In short, the chief drawbacks for ports on the west coast are shoals, the strong undercurrents, the amplitude of the tide, and the irresistible rush of tidal currents.

In India two classes of ports are met with, *viz.* the major and minor ports The major ports are administered by the Central Government and the 'minor ports' by the State Governments The sheltered nature of a port, the well-laid-out approach channels, the provision of docks, jetties and moorings, the well-laid-out transit sheds, the effective rail connections, the ability to serve a very large portion of the hinterland lying behind the port, the facilities for meeting the requirements of defence and strategy, the comparatively large volume of trade and possibilities of work for shifting all the year round, usually distinguish a 'major port' from a 'minor port' India has 6 major ports namely, Bombay, Cochin, Madras, Vishakhapatnam, Kandla and Calcutta. They together handled 31 0 million tons of traffic during 1957-58 India has a large number of minor ports (about 225 of which 150 are working ports) of these 18 are more important These are Kakinada, Masulipatam, Cuddalore, Kozhikode, Mangalore, Tuticorin, Allepy, Bhawnagar, Porbandar, Bedi, Nawalakhi, Okha, Quilon and Surat They handle about 50 lakh tons per annum.

The following table shows the cargo handled by important ports of India :

(*In deadweight Lakh tons*)

	1953-54			1959-60		
Ports	Imports	Exports	Total	Imports	Exports	Total
Bombay	47.7	19 7	67.2	94 22	37 33	131 55
Calcutta	27 2	53 3	80 5	49-54	46 75	96 29
Madras	15 6	4 7	20 3	18 12	9 07	27 19
Cochin	12 3	3 2	15 5	15 25	4 22	19 47
Vishakhapatnam	1 8	12 0	13.8	12 05	12 42	24 47
Kandla	—	—	—	8 28	3 00	11 28

(A) Ports on West Coast :

BOMBAY

The value of the site of Bombay lies in available depth of water The minimum depth of the main channel is 32 ft , and there is minimum of 37 ft of water at all states of the tide in the deep water anchorage in front of the docks The 32 ft. minimum is equal to the maximum available in the Suez Canal through which the majority of the ships visiting Bombay have to pass. It has a natural harbour directly on the sea. This

harbour is open at all times of the year Hence her volume of trade is always large

Bombay's communications with the interior are also good, having connections by Western and Central Railways for the Thal Ghat and the Bhor Ghat, the two points where the wall-like Western Ghat mountains are rendered sufficiently low, are within fifty miles of each other and are behind Bombay. They collect up the communications lines to focus them on to the Port. This means that the productive hinterland of Bombay, producing the surplus essential to every port, extends to include the fertile agricultural lands of the Deccan and also in the Ganga Valley. The hinterland of Bombay extends from western parts of Andhra, Madras and Southern parts of Mysore to Delhi in the north and includes western U.P., Rajasthan, Madhya Pradesh and Bombay.

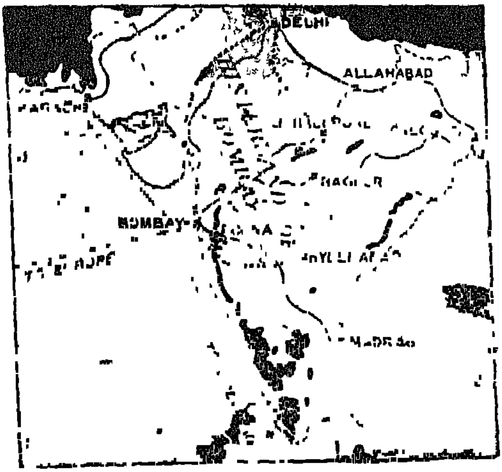


Fig 53. Hinterland of Bombay.

Bombay's greatest advantage as a good natural harbour is afforded by its island position The position of the docks in the shelter of the island of Bombay is safe from storms of the open sea The rail and road communications between the port and the mainland across the narrow creeks provide another advantage to Bombay Bombay is the nearest large port to Europe and North America with which we have the most of our foreign trade.

Because of the depth of water in the harbour the largest ships visiting India can come to Bombay only. All other ports in India can accommodate only ships of small tonnage On

account of the sedimentation noted above, it is necessary to employ dredgers continuously to keep the channel clear for big ships. The Bombay port has a large number of competitors

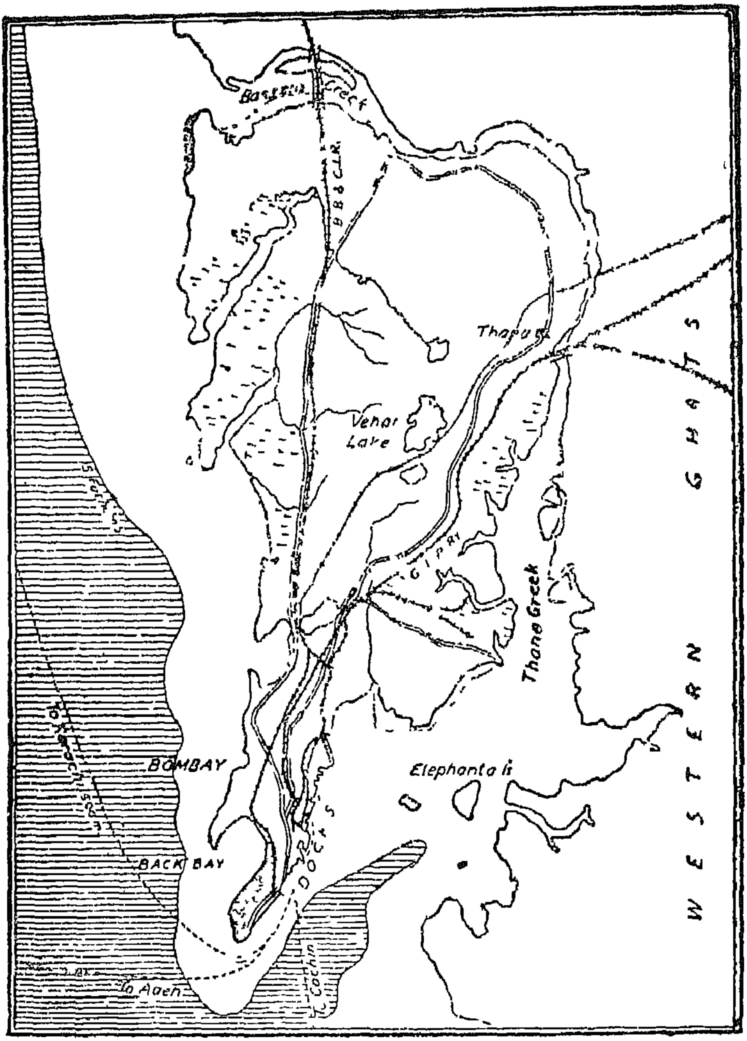


Fig 51 Location of Bombay

especially in the ports situated in Saurastra Calcutta has an advantage in this respect over Bombay, because the geographical conditions near Calcutta do not enable any rival port to

develop Bombay's position is unassailable as a passenger port, because the passenger ships are generally of large tonnage which can be accommodated only in Bombay.

Bombay is the principal outlet for the staple products of western India and Deccan. From her large quantities of wool and woollen goods, hides and skins, manganese ore, cotton textiles, oilseeds and mica are exported, while cotton piece-goods, mineral oil, machinery, raw cotton, railway plant, iron and steel goods, hardware, dyes, coal, etc, are imported from abroad

The following figures give the trade handled by Bombay.

Year	Imports (000 tons)	Exports (000 tons)	Total (000 tons)
1945-46	4,548	1,902	6,450
1949-50	4,927	1,358	6,285
1951-52	5,806	1,673	7,479
1953-54	4,775	1,651	6,426
1954-55	5,630	1,594	7,224
1955-56	6,647	3,528	10,175
1956-57	8,239	3,740	11,979
1957-58	9,302	3,808	13,110

Saurastra Ports

Saurastra with a coastline of about 500 miles and with only a small population possesses a number of seaports of considerable importance. By its geographical position Saurastra is best able to serve the trade of Rajasthan and the neighbouring regions. The trade at the Saurastra ports generally benefits from the cheaper wharfage and storage charges The labour charges are also lower than at Bombay The trade between Saurastra and Rajasthan is carried by the metre guage and the broad guage without the necessity of change from one guage to the other, as is the case wtih the trade between Bombay and certain parts of Rajasthan

The most important Saurastra ports are

(1) Bhavanagar, (2) Bedi Bunder, (3) Port Okha, (4) Navlakhi, (5) Verawal and (6) Porbandar.

1 *Bhavanagar* lies half-way up the Gulf of Cambay on its western side There is enough warehousing accommodation at the port and a good railway connection with the whole of India. Ships anchor about eight miles from the port and cargo is brought to the port by barges Owing to the constant silting, a new deep harbour was constructed in 1937 which can accommodate two ships at all times of the year.

2. *Bedi Bunder* was the first port to be developed in Saurastra It is situated in the Gulf of Cutch, with a long line of

sheltered sea coast, and has the unique advantage of being open at all seasons of the year. It does considerable coastal trade. As the sea is shallow, large steamer anchor about 2-3 miles away from the shore

3. *Okha* is situated in a detached port It is located at the extreme north-west point of the peninsula of Saurastra accessible readily to all steamers trading along that coast. The main disadvantage of this port is that the approach to channel from the sea is circuitous and risky. Another drawback is that Okha is far removed from large centres of population. The sea is deep enough for large vessels and the port is open at all seasons of the year The important exports consist of oilseeds and cotton, while sugar, chemicals, motorcars and machinery from the imports

4. *Navlakhi* is the principal port of Morvi and is situated on a spit of land in a tidal creek within the Little Gulf of Cutch. Large vessels can only come within a mile or so of the port after navigating mud banks at the entry to the Little Gulf. However, as the port is not exposed, it can be kept open throughout the year.

5 *Verawal* is a roadstead anchorage with masonry piers built at right angles to the shore It admits of small craft coming alongside the landing stage at all stages of the tide.

6. *Porbandar* is also an open roadstead, but with coral reefs protecting the inner harbour. There is a considerable traffic, which includes passenger traffic with East Africa. The harbour is closed during the monsoon

7 *Kandla.* To take the place of Karachi, which is now in Pakistan, the Government of India has developed Kandla as a major port Kandla is situated about 30 miles from the town of Bhuj and is at the eastern end on the Rann of Cutch The water here has generally a depth of 30 feet, but there is a sand-bar near the opening to the port, which reduces the depth The rail connections with Deesa-Radhanpur on the meter guage and with Jhund on the broad gauge have been constructed The supply of drinking water has also received attention. A colony has already been built at Gandhidham near Kandla Kandla has a natural sheltered harbour whose creek is easily navigable Its hinterland extends from Kutch and Saurastra to northern part of Bombay, Rajasthan, Punjab, Kashmir and Western U P. The hinterland is rich in fisheries, cement and glass materials, gypsum, lignite and bauxite

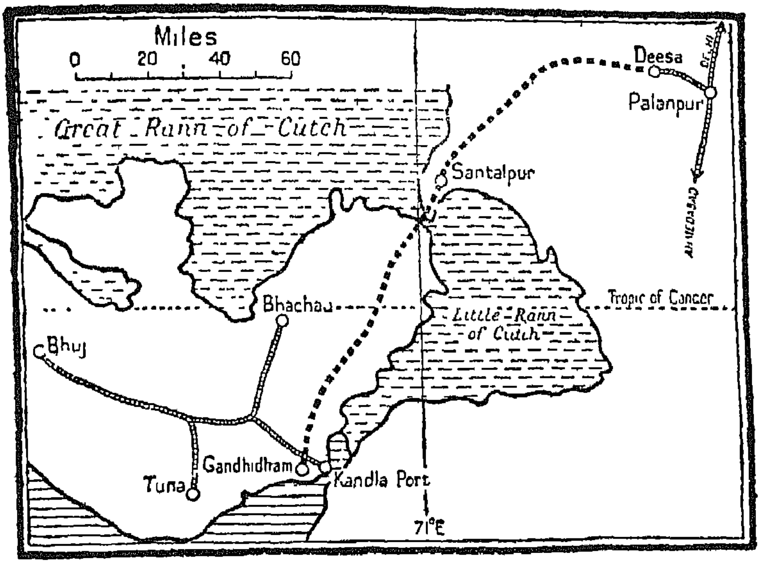


Fig. 55 Location of Kandla Sea port.

After the completion of the port fully, these facilities will be available at Kandla · (1) four deep water cargo berths, (ii) five mooring berths in the stream , (iii) four warehouses; (iv) a floating dry dock for small crafts , (v) an oil berth to take large tankers and (vi) a floating landing stage for passenger launches The traffic expected to flow through the port is expected to be about 850,000 tonns a year

8 *Kozhikode* (Calicut), lying 90 miles north of Cochin, a port of periodical importance because during the early monsoon period it is entirely closed to navigation Due to shallowness of the sea, steamers have to anchor about 3 miles off the shore Exports of this port are coir, coir-goods, coconuts Cocogem, rubber, coffee, ginger, spices groundnut and fish manures The imports consist of foodgrains, mineral oil, cotton textiles and machinery.

9 *Cochin* is the port of Kerala lying between Bombay and Colombo It is open for deep water traffic in the worst monsoons and provides a splendid anchorage for all seasons The principal articles of export are coir, yarn, coir mats, mattings, copra, spices, coffee, tea, rubber and coconut oil

(B) Ports on East Coasts:

Vishakhapatnam The port of Vishakapatnam was developed by building an improved harbour in the hope of handling the

increased traffic in maganese ore, as most of the manganese ore in India occur in its vicinity. The hopes of increased traffic were belied, owing to the fall in the exports of manganese ore due to world competition The port is the site of the ship-building docks of the Scindia Company Vishakhapatnam is situated on the Coromondal Coast about 500 miles south of Calcutta and 325 miles

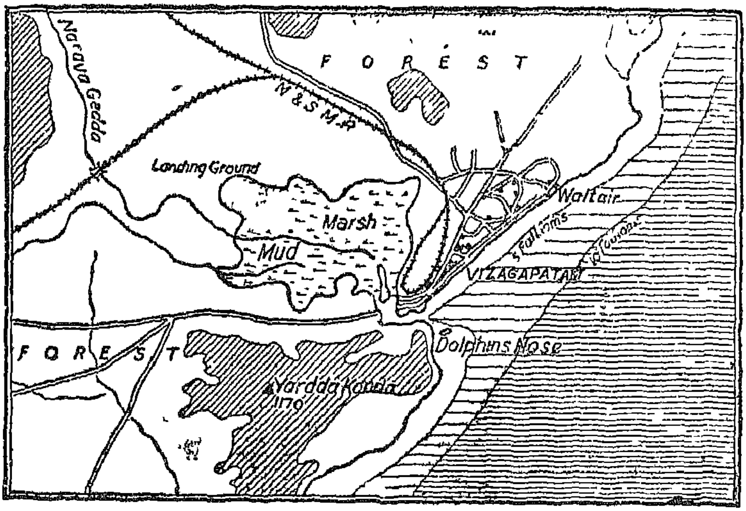


Fig 56 Location of Vishakhapatnam

north of Madras It offers better facilities for trade to Orissa and eastern part of Madhya Pradesh in contrast to Calcutta Its hinterland stretches from northern Madras, Andhra to Orissa and Madhya Pradesh The chief articles of export are hides and skin, timber, myrobolans, groundnuts, and manganese. Cotton Piece-goods, iron, and machinery are its chief imports

MADRAS

Madras is another important port on the coast serving the hinterland of Eastern Deccan plateau embracing the States of S Andhra, Madras, West Mysore But it suffers from two serious defects, *viz* its hinterland does not produce things which are required by European markets and secondly, many small ports on the Coromondal and Malabar coasts compete with it.

Madras harbour is the only port on the east coast which can admit vessels upto 26 feet draft It is an artificial harbour, enclosing about 200 acres of sea by quay-walls Dut to cyclonic

disturbances during October-November ships have to leave the port.

The chief imports of Madras are coal and coke, foodgrains, mineral oils, metals, timber, textiles, chemical and machinery, while exports consist of hides and skins, turmeric, groundnuts, mica, tobacco and textiles. The following table shows the trade handled by Madras :

Year	Imports (000 tons)	Exports (000 tons)	Total (000 tons)
1945-46	1,833	336	2,199
1949-50	1,592	191	1,783
1950-51	1,929	248	2,278
1953-54	1,569	471	2,041
1954-55	1,594	465	2,059
1955-56	1,716	485	2,201
1956-57	2,033	683	2,716
1957-58	1,885	618	2,503

CALCUTTA

Calcutta is the largest port in India It is situated about 80 miles away from the seashore. The Diamond Harbour has been built near the sea on the Hooghly for the stay of ships waiting the favourable tide for ascending to Calcutta. In Calcutta for loading and unloading of goods permanent docks have been built at Kidderpore

Like all other estuarine ports, Calcutta's shipping is at the mercy of the tides The ships can enter and clear the port only at fixed hours corresponding with the tides There are also a number of sandbars in the Hooghly which determine the size of the ocean-going ships by the depth of water. The sandbars are particularly numerous in the Hooghly, because of its tortuous course reducing the speed of the flow of the water and causing deposition of silt The silt brought down by the Damodar river also causes sandbars

The bars and crossings encountered in the river on the journey to the open sea are Panchparia Crossing, Sankrall Crossing, Manikholi Crossing, Pir Serang Crossing, Poojali, Crossing Moyapur Bar, Royapore Crossing, Fulta Crossing, East-Gur Bar (known also as the Jams and Mary), Kukrahatti Crossing, Balari Bar, Auckland Bar, Saugor Crossing, and Middleton Bar

While these names may appear somewhat meaningless to the layman, to those connected with the river they are of paramount importance. For instance, Saugor Crossing is the controlling bar in the river At this crossing there is perhaps only

24 to 30 feet of water—at times little more—and before the ships can enter or leave the port it must be conclusively ascertained that there is sufficient water on the bar to take a ship of any large draught

This is only one of the many points which have to be carefully checked by the pilot before the navigation operations are started

Cases have been known where a ship has crossed the controlling bar with but a few inches of water under her keel—

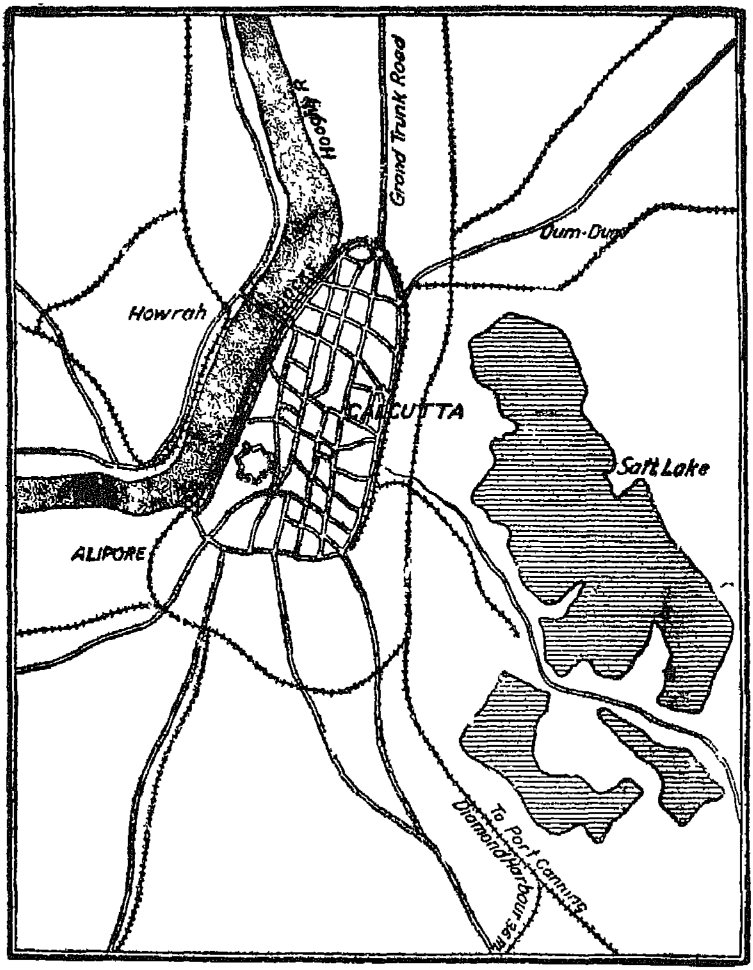


Fig. 57

and on more rare occasions vessels have actually scraped sand. More often than not ships anchor at Saugor, and wait for the next tide Of course certain vessels, for instance, the Rangoon Mail steamers make the journey very rapidly sailing up or down the river in roughly eight hours To shorten the distance, there is a proposal to dig a canal from Calcutta to the Diamond Harbour The length of this canal will be 30 miles

Calcutta has the advantage, on the one side, of being at the head of the Indo-Gangetic Basin which is the most densely populated area in India On the other hand, it is at the head of the biggest estuary of the Ganga, in the Bay of Bengal It is also connected easily with the eastern coastal plain and with the interior of the Plateau Region It is naturally the largest town of India. The port is well connected by railways, roads and the river to its hinterland which extends from Assam, West Bengal and Bihar to U.P., parts of Punjab, Orissa and Madhya Pradesh It also has the advantage of having in its hinterland a jute industry depending exclusively on foreign trade, India's premier coal mines, iron mines, petroleum mines, the mica mines, the manganese mines, and the tea estates, the products of all of which find their foreign market through Calcutta The iron smelting industry of India producing pig-iron for export is also in its hinterland. Other industries of the hiterland are rice-mills, tanneries, cotton mills, paper mills, perfumeries and match factories Under circumstances, Calcutta is bound to be an important port of India From the nature of things, Calcutta's trade is mostly in bulky and heavy articles which are not as valuable as the articles handled at Bombay. Owing to the tedious and dangerous river journey, passenger traffic at Calcutta is not large It is mainly with Burma. This traffic is handled in small ships, for the big passenger ships of the regular lines never visit Calcutta owing to the difficulties of river navigation The principal exports of Calcutta consist of raw and manufactured jute and jute bags, tea, mica, coal, iron ore, manganese, shellac, wood, iron and steel products, oilseeds. while the important imports are liquor, salt, chemicals, sugar, motor-cars, paper, petroleum, rubber, iron and steel goods and cycles

The following table gives the figures of trade handled by Calcutta:

Year	Imports ('000 Tons)	Exports ('000 Tons)	Total ('000 Tons)
1951-52	4,093	5,489	9,582
1952-53	3,319	6,354	9,673
1953-54	2,723	5,336	8,059
1954-55	3,240	4,573	7,813

1955-56	3,409	4,621	8,030
1956-57	4,353	4,342	8,695
1957-58	5,515	4,640	10,155

QUESTIONS

1 Discuss carefully the salient features of India's foreign trade

2 What are the important geographical factors determining port sites on the Western Coast of India ?

3 What geographical factors have been responsible for the development of Bombay as a Port?

4 Discuss fully the position of Calcutta as a Port

5 Compare the trade (export and import) of Madras with that of Bombay Account for differences, if any, in their export trade

6 How far are India and Great Britain dependent on each other for (a) raw materials, (b) manufactured goods ? Give reasons for your answer.

7 Which countries are the chief buyers of our manufactured cotton, oilseeds and tea? From where do we import machinery, silk and paper ?

8 What are the principal exports of India? Where is each produced and where is it sent ?

9 Write explanatory notes on the following

(a) Ports in South India

(b) Oilseeds trade of India

(c) Air-routes of India

Chapter 12
Population

DISTRIBUTION OF POPULATION

India occupies a unique position in the world in respect of her population She supports one of the largest populations on the face of the earth Monsoon climates have the notable features of supporting very dense populations, and India, being one of the largest monsoon lands in the world, naturally has the most outstanding position in this respect.

India's total population is the second highest in the world So far as land area is concerned she ranks seventh in the world next to U S S R , China, Canada, Brazil, U S A and Australia, She occupies 2 2% of the land area of the world and supports 15% of the world population against China's 19. The population of India is more than combined population of North America and South America, about twice that of Africa and about 44 times the population of Australia. It is 1 8 times the population of U S S R , 24 times the population of U S A and 7 times the population of U K Humanity consists not less than six and not more than seven persons for every person living in India The total number of people living in U S S R and U.S A put together is slightly smaller than the total number of people of India

The table below gives the population of the continents and some important countries of the world (1957)·

Continents

Africa	220,000,000	Europe (Ex U. S S R)	411,000,000
North America	238,000,000	Oceania	14,500,000
South America	124,000,000	U S S. R	200,200,000
Asia (Ex U S S R)	1,481,000,000	World	2,689,000,000

Countries (in thousands)

Australia	9,202	India	377,000
Brazil	58,456	Indonesia	81,000
Burma	19,434	Italy	48,001
Canada	15,601	Japan	88,900
China	582,603	Pakistan	80,167
France	43,300	Thailand	20,000
Germany	49,995	Union of S Africa	13,669
U. S S R	200,000		

The distribution of population is controlled by·

(a) the production of food; or

(b) the means to purchase food.

In industrial and commercial areas the incomes of people are considerable and they can, therefore, easily purchase the food that they require from other areas. These incomes, therefore, attract large populations which could not be supported by local production of food alone

In agricultural areas, however, the incomes are compartively low and the people have, therefore, to produce their own food. The density of population here is thus dependent upon the capacity of the local area to produce food.

In India the question of population is the question of the means of livelihood or the question of FOOD. More the food, greater the population. We find, therefore, that all those factors which affect the distribution of food in India also affect the distribution of population. It has been seen elsewhere in this book how the distribution of rainfall, the fertility of the soil and irrigation facilities determine the quantity of food that can be grown It has also been noted how quantity for quantity rice supports more people than wheat or millets It can be safely concluded that the distribution of population in India follows rice, and consequently rainfall; for rice is cultivated generally in the moister regions of India.

The average density of India according to the sensus of 1961 is 384 per sq mile It varies considerably from state to state, being as high as 4,614 in Delhi, 1125 in Kerala, and 1031 in West Bengal to as low as 20 in Andaman and Nicobar Islands, 90 in Manipur, 124 in Himachal Pradesh and 152 in Rajasthan.

As regards the population the most *densely populated* parts of India are found (i) in the valley of the Ganga, (ii) in the river deltas of the south, and (iii) the south-western coast comprising Kerala. The greatest density per square mile (averaging over a thousand people) is recorded in Kerala and central districts in Assam.

The *thinnest population* is found in (i) the hilly areas (the Himalayas and the associated hills), the desert of Rajasthan and (iii) the dry areas of Chhota Nagpur plateau, Baster and Orissa

In the Ganga Valley, the density decreases as one proceeds towards the north-west, because the rainfall becomes less and less This does not, however, apply to those areas where irrigation facilities are abundant and the soil is fertile. Thus, in

the Meerut Division with a vast network of canals and fertile soil, the density of population is high, even though the rainfall is low. In the lower valley of the Ganga and in the delta the population is thin, (even though the rainfall is heavy), because large areas are covered by the stagnant waters of the old beds of rivers which now breed malaria It must be remembered that rainfall controls the density of population in India only through its control on food production.

The greatest populations in the Punjab occur in the neighbourhood of the Himalayas where the rainfall is considerable and the irrigation facilities from wells and canals are also abundant The importance of irrigation facilities in the distribution of population in India is shown in the newly populated canal colonies of the Punjab Areas which were unpopulated deserts before the advent of canal irrigation show now fairly dense populations in the Punjab

In the Peninsula, except on the coastal plains, the density is generally low. This low density is due, *firstly*, to the broken topography of the Peninsula, and *secondly*, to the broken grow in areas of heavy rainfall. These forested regions are usually unhealthy, owing to bad drainage

The following table gives the varition in the density of population according to natural geographical divisions.

Region	Pop in Lakhs	Density per Sq mile
High Density Region		
Lower Ganga Plain	700	832
Upper Ganga Plain	389	681
Malabar-Konkan	238	638
South Madras	307	554
North Madras and Coastal Orissa	211	461
Total	1,845	660
Medium Density Region		
Trans-Ganga Region	259	332
South Deccan	315	247
North Deccan	239	246
Gujarat-Saurastra	161	226
Total	974	266

Low Density Region		
The Desert	46	61
Westen Himalayas	90	68
North West Hills	104	163
Eastein Himalyas	124	118
North Central Hill and Plateau	138	164
N E. Plateau	290	192
Total	792	129

India being an agricultural country, most of her population lives in small villages. There are about 3,018 towns and 5,58,089 villages in India By far the largest proportion of these villages, is villages with a population below 500. More than one-fourth of the total population of the country lives in such villages The following table shows the percentages of India's population living in villages or towns of different sizes·

Distribution of India's Population

Size of village or town		Number	Total population
Villages			
Under 500 inhabitants	..	3,80,020	78,300,000
500—1,000	.	1,04,208	72,900,000
1,000—2,000		51,769	71,100,000
2,000—5,000		20,508	59,100,000
Towns			
5,000—10,000	.	3,101	20,754,000
10,000—20,000	.	856	11,681,000
20,000—50,000		401	11,804,000
50,000—100,000	.	111	7,586,000
100,000—and above	.	73	23,551,000
Total No of villages	.	5,58,089	295,004,271
Total No. of Towns		3,018	61,825,214

Of the 436 4 million who constitute the total population of the country for which provisional figures of population are available according to the 1961 census 358 6 million or 82 2% live in villages and 77.8 million or 17 8% live in cities and towns The table below shows the gradual trend towards urbanization.

Percentage of Total Population

Year	Rural	Urban
1921	88 6	11.4
1931	87 9	12 1
1941	86.1	13 9
1951	82 7	17.3
1961	82 2	17 8

The low proportion of city dwellers is a marked feature in India, *e.g.* India has 27 3% of her population in towns and cities and compared with 67 3 percent in U S A , 80 7 percent in U.K ; 37.5% in Japan, and 32 8% in U S.S.R

In this country according to 1961 population Census there are 109 cities with a population of 10,0000 and over States having cities with a population of 100,000 or over are as follows

U. P	17 Cities	Mysore	6 Cities
West Bengal	12 ,,	Rajasthan	6 ,,
Maharashtra	12 ,,	Punjab	5 ,,
Andhra Pradesh	11 ,,	Kerala	4 ,,
Madras	9 ,,	Jammu and Kashmir	2 ,,
M. P	8 ,,	Delhi	2 ,,
Bihar	7 ,,	Assam	1 ,,
Gujarat	6 ,,	Orissa	1 ,,

The following table shows the principal cities each having a population of over 5 lakhs:

Greater Bombay	41,46,491
Calcutta (including Howrah. and southern suburbs)	36,26,188
Delhi	23,44,051
Madras	17,25,216
Hyderabad	12,52,337
Ahmedabad	11,49,852
Kanpur	9,47,793
Bangalore	9,07,627
Poona	7,21,131
Lucknow	6,62,196
Nagpur	6,13,186

A little less than one-half of the total number of villages in India is in the Indo-Gangetic Valley, the valley of the Ganga being the more important The number of villages in the Ganga Valley was about 270,000 in 1951. The largest number of villages in India is found in U.P Generally speaking, owing to the fertility of the soil and the consequent capacity to support large population the villages are more closely settled in the valley of the Ganga than in other parts of the country. In Bengal the average area falling to the share of one village is a little less than one square mile. In Bombay, on the other hand, the average area for a village is about 5 square miles.

In the next table below are given the geographical area, population and density of population of the States in India:

States and Union Territories	Geographical Area (sq miles)	Population 1961	Density of Population per sq mile
States			
Andhra Pradesh	1,06,052	3,59,77,999	339
Assam	84,899	1,18,60,059	252
Bihar	67,198	4,64,57,042	691
Gujarat	72,226	2,06,21,283	286
Jammu & Kashmir	86,024	35,83,585	—
Kerala	15,005	1,68,75,199	1125
Madhya Pradesh	1,71,210	3,23,94,375	189
Madras	50,132	3,36,50,917	671
Maharashtra	1,18,741	3,95,04,294	332
Mysore	74,191	2,35,47,081	318
Orissa	60,162	1,75,65,645	292
Punjab	47,084	2,02,98,151	431
Rajasthan	1,32,150	2,01,46,173	152
Uttar Pradesh	1,13,454	7,37,52,914	650
West Bengal	33,928	3,49,67,634	1031
Union Territories			
Andman and Nicobar Islands	3215	63,438	20
Delhi	573	26,44,058	4,614
Himachal Pradesh	10,879	13,48,982	124
Laccadive, Minicoy, and Amindivi Islands	11	24,108	2,192
Manipur	8628	7,78,318	90
Tripura	4036	11,41,492	283
Dadra and Nagar Haveli	189	—	—
Goa, Daman and Diu	1426	—	—

India has a population density of 384 persons per square mile The density table shows the density of population in different states of India

Comparative figures of density of population per square mile available in respect of some other countries are given below:

U S S R	23	England and Wales	724
U. S. A.	50	Japan	583
Java and Malaya	818	Belgium	734
China	123	Netherlands	826
Pakistan	208	Australia	3
Italy	399	Canada	4
Germany	505		

GROWTH OF POPULATION IN INDIA

A characteristic of India's population is its large increase. Between 1850 and 1950 we added a very large figure to our existing population in absolute numbers, *i.e.* an average of 23 millions per decade as against only 4 4 millions in Brazil, 13 millions in U S A., 2 millions in Argentine and 3 millions in England and Wales.[1]

Basing his conclusions on *Ain-i-Akbari* Mr Shirras has estimated the population of India to have been 100 millions in 1590, and it was about 150 in 1850 It stood at 254 millions in 1871 Since then it has increased but this growth has been quite uneven During 1891-1921 it had been irregular and fitful due to severe famine, bubonic plague, cholera and malaria and influenza epidemic so that the net increase during these 30 years was only 12,200,000. But the period from 1921 onwards has been a rapid growth in population, yielding a net addition of 27,4000,000 This addition during these last thirty years is thus more than double the addition to the population during the 1891-1921 period Hence, the year 1921 is regarded as 'Great Divide' in the Indian Census

The following table gives the growth of population in the Indian Union since 1891.

Year	Population in millions	Increase in millions	Percent of Increase
1891	235 90	—	—
1901	235 50	—0 4	-0 7
1911	249.05	13.55	-5 8
1921	248 18	0.87	+0 3
1931	275 52	27 34	-11.0
1941	314 77	39 25	+14 3
1951	356 88	42.11	+13 4
1961	437 20	80.32	+21.5

1 C B Mamoria, *India's Population Problem*, in *Economic Review*, Vol VIII No 7 (August 1, 1956) p. 14 Also his, *Our Demographic Situation and Its Solution* in *Economic Review*, Vol IX No 7 8 (Aug 15, 1957) p, 77-74,

The following table gives the mid-year population in India:

1952	36 75 Crores	1956	38 74 Crores
1953	37 23 ,,	1957	39 24 ,,
1954	37 71 ,,	1958	39.75 ,,
1955	38 24 ,,	1961	43 72 ,,

The chief causes for the remarkable growth of population, particularly in the last three decades, may be enumerated thus:[1]

(i) The prevalence of peaceful conditions in the country

(ii) Subsequent improvements in the method of census operation over the previous decades

(iii) The *rapid development* of the means of transport

(iv) Improvements in medical facilities and health measures

(v) The high birth and death rates have definitely played a vital part in determining the population growth In 1960, the birth rate was estimated to be 24 6 per thousand and death rate to be 10 4 per thousand persons Hence we have survival rate of 14 2 per thousand live births, which is higher than those of France, U K, Germany, Belgium and Denmark but is lower than those of U S A, Canada, Brazil and Ceylon Though of late birth rate is falling a little but decline in death rate is more readily evident.[1]

(vi) The university of marriage and the prevalence of the practice of early marriage among the population The percentages of unmarried persons in India aged 15 and over, are 20 3 among the males and 6 4 among the females, *i.e.* unmarried persons (both sexes) form 44 1% of the population

(vii) The rampant poverty and low standard of living of the masses leads to a torrent of unwanted babies

(viii) Being a hot country, girls in India attain puberty very early between the ages of 12-15 so that a lass of 15 is found to be a mother 80% of the girls in India in the most fertile period (15-20) are found to be in wedlock An average Indian woman gives birth to between 6 and 7 children during her production period (15 to 45 years) This is very much higher than the figures for other countries In Japan it is 5 3, in U S A, 3.3 and in England 2 6

1 Mamoria, *Op. Cit*, p 14 16

(ix) Our rigid social framework, characterised by caste system and joint family system also makes for a low capilarity

(x) Our population has a high replacement tendency as our Net Reproduction Rate is 1 454

It is the considered opinion of the Census Commissioner that unless the rate of growth of population is checked by contraception or by a breakdown of food supply of a serious nature, population will increase during 1951-80 at a faster rate than during 1921-50 Thus according to him the population will grow from 36 crores in 1951 to 41 crores in 1961, 46 crores in 1971 and to 52 crores in 1981 But as the actual figures for 1961 have surpassed the estimates of Census Commissioner, it may be expected that future predictions regarding growth of population will also be superceded

In India not only the birth and death rates are high but infantile and maternal mortality is also very high This high death rate is a clear evidence of the large amount of disease and waste of life The hot and moist climate during the long summer months of India breed numerous parasites which prey upon the health of man Malaria and other types of fever prevalent in India are the cause of a great wastage of life in this country It has been estimated that nearly 7,50,00,000 persons suffer from malaria in any normal year and it takes a toll of at least 300,000 lives It is further estimated that about 25 lakh active cases of T B exist annually and that 5 lakh deaths take place each year from this fatal disease.

The low standard of living to which vast majority of the people in India are accustomed causes a low physical development which easily succumbs to the attacks of disease An average Indian's food is insufficient not only in quantity but also in quality (the average calorie supply per capita is only 1,600 or so as against 2,200 accepted by the F A O as the minimum standard) The diet is almost invariably ill-balanced and there is a deficiency of fats, vitamins and proteins of high biological value Besides India ranks high as one of the largest reservoirs of infectious diseases. Mal-nutrition and under-nutrition reduce the vitality and power of resistance of an appreciable section of the population The result of all these factors has been that the duration of human life in India is very short It is only 41 68 years for males and 42 06 years for females (1956-61) as against 26 91 for males and 24 56 for females in 1931 This expectation of life is very great in U K, Australia, New Zealand, etc

In order to increase the National Income in India it is necessary to reorganise our agriculture on a better plan, so that

more land should be available for commercial crops This re-organisation should enable us to grow more food on limited areas by improved agricultural methods It should also free a large number of people from agriculture to take up work in industries and commerce and thereby reduce pressure of population on land To absorb the growing numbers a policy of systematic industrialisation should be followed by the country India is a country of great industrial potentialities and given the necessary encouragement. It should not be difficult to hold her own in the industrial world of tomorrow A balanced economy between agriculture and industry can thus result, enabling India to feed and clothe her millions decently. Lastly, a plain for the elimination of improvident maternity in India through the adoption of efficient, harmless and economical methods of birth control and high literacy standards in the country must be framed

QUESTIONS

1. Discuss the influence of geoprahical factors on the distribution of population in India

2 What are important characteristics of population distribution in
(a) the Ganga Valley?
(b) the Peninsular India ?

3 Why does most of the population of India live in villages and not in towns ?

4 What are the main features of the village in different parts of India from the point of view of population ?

5 Why is the death-rate so high in India?

6 What steps will you suggest for raising the National Income in India ?

7 Analyse the factors which determine the irregular disribution of population in India

8. Show how far rainfall controls density of population in India.